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UNITED STATES
DEPARTMENT OF THE INTERIOR
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BUREAU OF MINES
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INFORMATION CIRCULAR

RECONNAISSANCE OF MINING DISTRICTS IN LANDER COUNTY, NEVADA

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BY

WILLIAM O. VANDERBURG

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

RECONNAISSANCE OF MINING DISTRICTS IN LANDER COUNTY, NEVADA[1/]

By William O. Vanderburg[2/]

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2/ Mining engineer, Mining Division, Bureau of Mines, United States Department of the Interior.

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FOREWORD

This is one of a series of circulars dealing with mining and milling operations in various mining districts of the western United States. Data on operating costs, grades of ore treated, wage scales, haulage and trucking rates, and freight and treatment charges, together with other information on mining properties, are obtained from the operators and other local sources during the course of field inspections. The data are believed to be substantially correct as of the dates when the districts were visited, but later disclosures resulting from further exploration and development may have changed the economic picture appreciably.

Charles F. Jackson,
Chief engineer,
Mining Division.

INTRODUCTION

This report[3/] gives the results of a reconnaissance of the mining districts in Lander County, Nev., made from March 29 to April 20 and from May 9 to May 21, 1938, during which virtually all of the mining districts in the county were visited. No attempt has been made to include in this report all the mines and prospects in the various mining districts, and it should be stated that whether or not a property is mentioned herein has no bearing on its merits. The report covers the situation of the various districts, types of ore deposits, ownership and description of mines and prospects, information on past and current activity, and other information of economic interest likely to be useful to those interested in the development of our mineral resources.

The names of the various districts mentioned are those generally used when they were organized for purposes of record and regulation. When originally organized, the districts embraced large areas with no well-defined boundaries, so that the names have little geographical significance.

Mining was begun in Lander County in the early sixties as the result of the discovery of silver ore in the Reese River district. Following this discovery numerous others ensued, which caused mining stampedes in various parts of eastern Nevada. These mining "rushes" were primarily responsible for the occupation and settlement of the greater part of Nevada, for without them large areas would have remained unexplored and their development postponed many years.

3/ Manuscript completed July 15, 1938.

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From the viewpoint of past production, the silver deposits at Austin have been the most important, followed by the copper, silver, and placer-gold deposits of the Battle Mountain area. The greatest mining activity in Lander County took place from 1862 to 1880, when the Reese River district was one of the leading mining areas in the State.

In recent years mining activity within the county has been largely in the hands of lessees; the writer estimates that during 1937 an average of 120 men were gainfully employed in the mineral industry of the county. The Battle Mountain region has been one of the principal leasing areas in the State for many years. Most of the ores produced by lessees are shipped to smelters near Salt Lake City, Utah.

With the present outlook, future production of metals from Lander County will depend largely on further exploration in the known mineralized areas and the rehabilitation of old mines to work ores that were uneconomical to mine and treat in former years. In the industrial mineral group, barite is the only mineral that has been commercially important.

ACKNOWLEDGMENTS

The author wishes to thank the owners, lessees, and mine operators, too numerous to mention individually, who wholeheartedly provided information and assistance during the course of the field work.

B. F. Couch, secretary of the Nevada State Bureau of Mines, Reno, Nev., made available to the writer published data pertaining to early mining activities in Lander County; and Charles White Merrill, of the Mineral Production and Economics Division, Bureau of Mines, compiled the figures for the mineral-production tables in this report. Credit for such data as were used is given in the text.

LANDER COUNTY

Political History

The region within the present boundaries of Nevada originally comprised part of the territory purchased by the United States from Mexico under the treaty of Guadalupe Hidalgo consummated in 1848. Prior to its alienation from the Republic of Mexico, it was included in the department of "Alta California." After its acquisition by the United States, it constituted the western part of the Territory of Utah, from which it was separated by an Act of Congress approved March 2, 1861, to form the Territory of Nevada. The Territorial status was maintained until October 31, 1864, when by proclamation of President Lincoln it was admitted into the Union as the thirty-sixth State.

Lander County was created and organized by an Act of the Territorial Legislature approved December 19, 1862. The temporary county seat was Jacobsville (Jacobs Springs), a station on the Overland Mail and Pony

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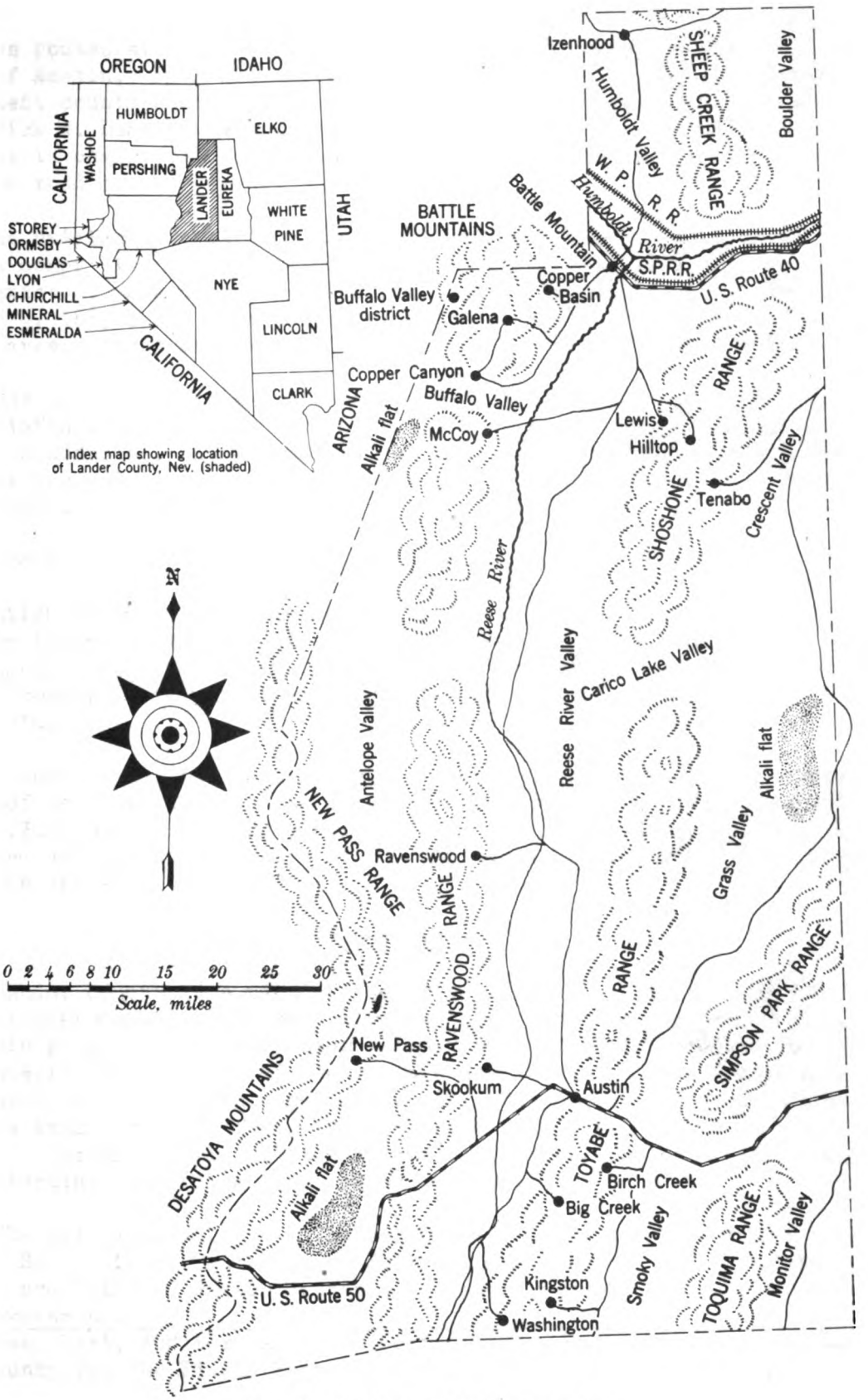

Figure 1.—Sketch map of Lander County, Nev.

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Express routes situated on the Reese River 7-1/2 miles west of the present site of Austin. By a general vote in September 1863, Austin was made the permanent county seat. The name of the county was bestowed in honor of Gen. Frederick W. Lander, who played an active part in the Indian War of 1860 and who was in charge of the construction, by the United States Government, of a wagon road across Nevada.

As originally organized, Lander County was a vast, largely unexplored region comprising about one-third of the area of Nevada as its boundaries then existed. Subsequently White Pine County (March 2, 1869), Elko County (March 5, 1869), and Eureka County (March 1, 1873) were created from this large area, giving Lander County the title of "Mother of Counties."

The early boundaries between the various counties were sometimes vague and indefinite, so that numerous controversies arose over the position of county boundaries. Lander County had a number of boundary adjustments, so that at present it comprises 5,721 square miles. Figure 1 is a sketch of the county.

According to the 1930 census, the population at that time was 1,714, and the population in 1938 is nearly the same. The major part of the population resides in Battle Mountain, the principal mining center, situated in the northern part of the county, and at Austin, the county seat and supply center for mining districts and ranches in the southern portion of the county. The principal industries are stock raising, agriculture, and mining.

According to the annual report of the county auditor,[4/] the assessed value of real property in the county at the end of the fiscal year 1937 was $5,364,707, and the tax rate for the same period was $2.64 per $100 of assessed valuation, exclusive of special taxes but including the State tax of $0.68 per $100.

Topography

Lander County is a part of the Great Basin; it has the characteristic basin topography, a semidesert plateau traversed by a succession of narrow mountain ranges with intervening valleys approximately parallel and having a northward trend. Most of the valleys are independent basins hemmed in by mountains; none have drainage to the sea. The general altitude of the valleys is about 4,500 feet, the mountains rising from 4,000 to 5,000 feet higher. Through nearly all the ranges are passes, and open plains surround their termini, affording easy routes of travel.

The principal valleys in Lander County are Antelope, Buffalo, Crescent, Grass, Reese River, Smith Creek, Smoky, and Humboldt. The principal mountain ranges are Toiyabe, Battle Mountain, Shoshone, Toquima, Desatoya, New Pass, and Ravenswood.

4/ Acree, Bert, Auditor, Annual Report of the County Auditor of Lander County for the Fiscal Year Ended June 30, 1937.

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The Humboldt River, the largest stream wholly within the State, flows westerly across the northern part of Lander County through the valley of the same name.

Water Resources

The principal streams in Lander County are the Humboldt and Reese Rivers. The latter rises in the Toiyabe Range in the southern part of the county and flows northward to join the Humboldt River near Battle Mountain. Near its source the volume of water is considerable, but most of the water is either lost by evaporation or utilized for irrigation, so that the water seldom reaches the Humboldt.

The higher mountain ranges are traversed by numerous V-shaped canyons, in which flow small mountain streams. Only a few such streams are perennial.

A large number of hot and cold springs are scattered throughout the county. The town of Battle Mountain is supplied with artesian water from wells near the town.

The long, narrow valleys intervening between parallel mountain ranges form receptacles for the accumulation of underground water, so that if not otherwise available, water for milling purposes generally can be developed by sinking wells in the valleys, usually within convenient distances of most of the districts mentioned in this report.

Climate and Vegetation

The precipitation in Lander County, largely in the form of snow, varies according to the altitude and ranges from 5 to over 20 inches per year. According to data compiled by the Nevada Agriculture Experiment Station, approximately 39 percent of the area of Lander County (5,721 square miles) has a precipitation of 5 to 8 inches per year, 49 percent has 8 to 15 inches per year, and the remaining 12 percent, comprising the higher mountainous areas, has 15 to over 20 inches. In the summer an occasional cloudburst may occur, which, though of short duration, may be exceptionally severe. A cloudburst in the vicinity of Austin on August 18, 1874, partly destroyed the town.

During the summer hot, cloudless days prevail, but since the atmosphere is dry the heat is seldom oppressive. The diurnal range in temperature is considerable, and a hot day may be followed by a frosty night. Winds are frequent, and they may have sufficient velocity to send sand and dust clouds high into the air. A peculiar phenomenon during the summer months is the whirlwinds or miniature tornadoes of sand and dust that twist and gyrate in huge columns, majestically traveling through the valleys for miles.

Some sort of vegetation, although limited as to variety, is prevalent over the entire county, with the exception of the valley depressions covered with deposits of alkaline salt. On the mountain ranges above a

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general altitude of 7,000 feet, the greater precipitation favors sparse forest growths; the dwarf juniper (Juniperus occidentalis), foxtail pine (Pinus balfouriana), Utah juniper (Juniperus utahensis), locally called cedar, piñon pine (Pinus monophylla), limber pine, (Pinus flexilix), native cottonwood (Populus fremonti), western redbirch (Betula fontinalis), and mountain mahogany (Cerocarpus lediforius) are the most common. The piñon pine is the most prevalent, exceeding in quantity all the other conifers combined. It is bushlike, rarely exceeding 20 feet in height. All timber is small, except the limber pine, which may attain a diameter of 3 feet and a height of 50 feet. It is found in scattered stands at altitudes above 9,000 feet in the Toiyabe Range. In pioneer days it was logged and was the only local source of saw-timber. The only hardwood tree is the mountain mahogany. The mahogany and piñon pine are generally used for fuel.

The lower country is generally covered by the common sage (Artemesia tridentata), which grows vigorously. White sage, bunch grass, and other varieties of nutritious grasses furnish excellent forage for cattle and sheep.

Power Facilities

In the early days, power for mining was generated in steam plants, wood from the mountain slopes being used for fuel. At present all the mining districts in Lander County depend upon internal-combustion engines for power, since purchased electric power is not available.

Transportation Facilities

The main lines of the Southern and Western Pacific Railroads traverse the northern part of Lander County, roughly paralleling the course of the Humboldt River. The Southern Pacific passes through Battle Mountain and the Western Pacific several miles north of the town. The Nevada Central narrow-gage railroad connecting Austin with Battle Mountain was abandoned in 1937 and the equipment sold.

The Southern Pacific freight rates per ton of ore from Battle Mountain, the principal shipping point, to Utah smelters are as follows:

Value of ore per ton 1/	$10	$15	$20	$30	$40	$50	$60
20-ton	3.96	3.96	5.06	5.61	6.16	6.71	7.26
40-ton	-	3.30	3.52	4.18	4.84	5.23	5.78

Value	$70	$80	$90	$100	$110	$120	$150	$200	$400
20-ton	7.81	8.36	8.58	8.91	10.01	10.29	10.34	11.00	11.00
40-ton	6.60	7.43	8.14	8.80	-	-	-	-	-

1/ The railroad value per ton is the smelter value, less treatment charge, divided by the total number of tons (wet weight) in the shipment.

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The town of Battle Mountain is on United States route 40 (Victory Highway), and Austin, in the southern part of the county, is on United States route 50 (Lincoln Highway), both roads connecting Salt Lake City, Utah, with Reno, Nev., and places west. These two highways are hard-surfaced; all others in the county are either natural or gravel. Virtually all the districts mentioned in this report are accessible by automobile.

History of Mining

Prior to 1848, the only white inhabitants within the present limits of Nevada were a few itinerant trappers and hunters. The aboriginal tribes, principally Shoshones and Paiutes, numbering perhaps between 10 or 12 thousand people, roamed this vast region, but they were not versed in the art of mining metals. The first white man known to have crossed the Great Basin, lying between the Wasatch Mountains on the east and the Sierra Nevada Range on the west, was Jedediah Strong Smith, with a company of 40 trappers. The route probably taken by Smith in 1825 on his trip from the Yellowstone River to California led through the southeastern portion of the State following, for part of his journey, the course of the Humboldt River, which he named Mary's River. Other exploration and emigration parties crossed the northern part of the State from east to west following the route along the Humboldt River; among these were the Peter S. Ogden expedition sent out by the Hudson Bay Co. in 1831; Milton Sublette's expedition for the Rocky Mountain Fur Co. in 1832; Capt. B. L. E. Bonneville and Joseph Walker's expedition in 1833; Thomas McCoy-Christopher (Kit) Carson's expedition also in 1833; the John Bidwell-J. B. Bartelson emigration party in 1841; and Gen. John Fremont's expedition in 1843-1844. All of these expeditions followed closely the course of Mary's River (renamed the Humboldt by Fremont), the safest and most natural travel route across the Great Basin. Due to the forbidding character of the country, the Great Basin region outside of the narrow strip along the Humboldt was the last portion of the United States to be explored. Even the route along the Humboldt was not accurately mapped as late as the Bidwell-Bartelson expedition in 1841. At that time it was the general belief that a great river flowed westward across the Great Basin from Great Salt Lake and through the Sierra Nevada Mountains to the Pacific Ocean. Amusing as it may seem today, Bidwell was advised to take tools to construct boats for traveling by water to the Pacific Coast.

The discovery of placer gold in California in January 1848 by James Marshall precipitated a rush to the coast in 1849 and 1850, and numerous settlers and adventurers crossed Nevada along the course of the Humboldt River. The early pioneers crossed the arid stretches of the State with a minimum of delay, and none of them left any impression on eastern Nevada as far as mineral discoveries are concerned.

Prior to 1862, the greater portion of eastern Nevada remained unexplored. The lodestone that first attracted attention to Nevada was the discovery of silver in the Washoe district (Comstock) in 1859. With this discovery, an army of prospectors, miners, and adventurers flocked to western Nevada. This discovery resulted in the improvement of communication and transportation facilities across the State; in the spring of 1860, the

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celebrated Pony Express was established by Jones Russel & Co. The Pony Express operated only about a year, being supplanted by the transcontinental telegraph line completed by the Overland Telegraph Co. on October 24, 1861. The route used by the Pony Express across the State was known as the Overland route, first surveyed by Captain (later Colonel) J. H. Simpson for the United States Government in 1859. The Overland Mail & Stage Co. began operating in July 1861, following the route surveyed by Simpson. This route remained the principal line of travel across the State until the completion of the Central Pacific Railroad in July 1869.

The first mineral discovery in eastern Nevada was made in what is now Lander County in 1862. The history of this discovery, according to Angel5/ is as follows:

> Early in the month of May 1862, William H. Talcott, an attache of the stage station at Jacob's Springs (Jacobsville), a post on the transcontinental stage route, while hauling wood from the hillside, now within the limits of the city of Austin, discovered a vein of metal-bearing quartz and carried a small quantity with him to the Station. The rock proving to contain silver, the ledge was located as a mining claim, named the Pony, as the discoverer had formerly been a rider of the Pony Express. On the tenth day of May 1862, a mining district was formed, including an area 75 miles in length east and west, and 20 miles north and south, and named the Reese River mining district. A code of laws was adopted after the custom of miners, and William H. Talcott, the discoverer, was elected recorder, and the claims already discovered were recorded.

The present law under which mining rights are acquired on the public mineral domain was passed by Congress on May 10, 1872. Prior to this time the customs and laws of Nevada permitted miners to organize a district, designate its boundaries, and pass a code of laws regulating the tenure of mining property. The validity of such rules and regulations was acknowledged by Congress, and they are historically interesting for they formed a connecting link in the evolution of our present mining laws. The first regulations in the Reese River district were adopted in July 17, 1862, but the district was reorganized on June 4, 1864. The mining regulations of the Reese River district adopted on June 4, 1864, were as follows:

> SECTION 1. The district shall be known as the Reese River mining district, and shall be bounded as follows, to wit: On the north by a distance of 10 miles from the overland telegraph line, on the east by Dry Creek, on the south by a distance of 10 miles from the overland telegraph line, and on the west by Edward's Creek, where not conflicting with any new districts formed to date.

5/ Angel, Myron, History of Austin and Reese River Region, published in Harrington's Directory, 1866. Cited by Browne, J. Ross, Mineral Resources of the States and Territories West of the Rocky Mountains: D. Appleton & Co., New York, 1869, p. 395.

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SECTION 2. There shall be a mining recorder elected on the first day of June next for this district, who shall hold office for 1 year from the 17th of July next, unless sooner removed by a new election, which can only be done by a written call, signed by at least 50 claimholders, giving notice of a new election to be held, after said notice shall have been posted and published for at least 20 days in some newspaper published in or nearest this district; and the recorder shall be a resident of this district.

SECTION 3. It shall be the duty of the recorder to keep in a suitable book or books a full and truthful record of the proceedings of all public meetings; to place on record all claims brought to him for that purpose, when such claim shall not interfere with or affect the rights and interests of prior locators, recording the same in the order of their date, for which service he shall receive one dollar ($1) for each claim recorded. It shall also be the duty of the recorder to keep his books open at all times to the inspection of the public; he shall also have the power to appoint a deputy to act in his stead, for whose official acts he shall be held responsible. It shall also be the duty of the recorder to deliver to his successor in office all books, records, papers, etc. belonging to or pertaining to his office.

SECTION 4. All examinations of the record must be made in the full presence of the recorder or his deputy.

SECTION 5. Notice of a claim of location of mining ground by any individual, or by a company, on file in the recorder's office, shall be deemed equivalent to a record of the same.

SECTION 6. Each claimant shall be entitled to hold by location 200 feet on any lead in the district, with all the dips, spurs, and angles, offshoots, outcrops, depths, widths, variations, and all the mineral and other valuables therein contained, the discoverer of and locater of a new lead being entitled to one claim extra for discovery.

SECTION 7. The locater of any lead, lode, or ledge in the district shall be entitled to hold on each side of the lead, lode, or ledge located by him or them 100 feet; but this shall not be construed to mean any distinct or parallel ledge within the 200 feet other than the one originally located.

SECTION 8. All locations shall be made by a written notice, posted upon the ground, and boundaries described, and all claimants' names posted on the notice.

SECTION 9. Work done on any tunnel, cut, shaft, or drift, in good faith, shall be considered as being done upon the claim owned by such person or company.

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SECTION 10. Every claim (whether by individual or company) located shall be recorded within 10 days after the date of location.

SECTION 11. All miners locating a mining claim in this district shall place and maintain thereon a good and substantial monument or stake, with a notice thereon of the name of the claim, the names of the locaters, date of location, record, and extent of claim. It is hereby requested that owners in claims already located do comply with the requirements of this section.

SECTION 12. The recorder shall go upon the ground with any and all parties desiring to locate claims, and shall be entitled to receive for such service 1 dollar for each and every name in a location of 200 feet each.

SECTION 13. It is hereby made the duty of the mining recorder, upon the written application of 25 miners, to call a meeting of the miners of the district by giving a notice of 20 days through some newspaper published in the Reese River district, which notice shall state the object of the meeting and the place and time of holding the same.

SECTION 14. The laws of this district passed July 17, 1862, are hereby repealed.

The name of Reese River was first given to the large stream bearing this name by Captain Simpson in honor of John Reese, a Mormon pioneer, who was one of the first to cross the State by the Overland route.

The news of the discovery of silver in the Reese River district spread rapidly, and thousands of people flocked to the locality, since it was situated on the line of the Overland stage and telegraph. This discovery opened at one bound the vast unexplored regions of eastern Nevada that hitherto contained no single permanent settlement. A great army of prospectors, miners, adventurers, along with a few home seekers, began a trek from California, Virginia City on the Comstock, and from the Eastern States. By the fall of 1863 the boom had reached its peak. One observer at that time counted 274 freight teams, 19 passenger wagons, 3 pack teams, 69 horsemen, and 31 people on foot on a trip between Austin and Virginia City.6/ Probably nearly again as much traffic could have been observed coming from the East along the route between Austin and Salt Lake City, Utah. During the summer of 1863, 366 houses were erected in Austin and the population numbered over 6,000 people.

Following the organization of the Reese River district, prospecting was carried on with great vigor, first north and south along the Toiyabe Range, in which Austin is situated, and later to other portions of eastern Nevada as far south as the Colorado River. At the close of 1865, at least 60 mining districts had been organized, in which it has been estimated fully

6/ Farrell, M. J., Address before Society of Reese River Pioneers: Published in the Reese River Reveille, Aug. 27, 1874.

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20,000 mining claims had been recorded. From the discovery of the Comstock in 1859 to 1870 was the period of the greatest prospecting activity Nevada ever experienced. Austin was the nucleus from which sprang most of the settlements of eastern Nevada. With Austin as a base for prospecting, a number of prominent districts were discovered, including Reveille, Northumberland, Hot Creek (Tybo), Silver Bend (Philadelphia), Belmont, Mammoth, Twin River, and Union in Nye County; Eureka, Mineral Hill, and Cortez in Eureka County; Tuscarora (first known as Goose Creek) in Elko County; Egan Canyon (Cherry Creek) and White Pine (Hamilton) in White Pine County; and Battle Mountain in Lander County. Numerous other districts were organized, many of which excited great hopes by promises of unbounded wealth, only to lapse into obscurity after a brief period of activity. It was a period when anything new in mining had tremendous possibilities, and the only fear was that the enormous quantity of silver believed to be present in the mountains of Nevada would destroy the value of that metal and upset the monetary stability of the world.

During the greater part of the summer of 1863 the number of incorporations of mining companies in the Reese River district averaged 10 per day, many days being as high as 60. It is reported that there were 1,500 mining offices in San Francisco, a large proportion of which were opened by Reese River companies. Anything that resembled quartz or a seam that had even a remote possibility of leading to ore was located and a company immediately incorporated. In the early days of Nevada mining, locations were made in "feet" and either sold or traded in the same manner as mining stocks are today. "Feet" were staple currency, and an original claim 200 feet in length was speedily incorporated and reduced to fractions of 5, 10, 20, or 50 feet or other denominations, depending upon the locater's valuation of the claim. Such fractional parts of a claim were either sold for cash or exchanged for other feet of greater or less value, according to the business acumen of the parties involved. If the property developed into a promising mine under such an incorporation, the stock (feet) was frequently so scattered as to prohibit advantageous action.

One of the greatest drawbacks to intelligent development of mining properties in the Reese River and other districts was the lack of experience in mining and milling. Generally the locaters knew nothing of practical mining, and many false estimates were made on the value of properties without any intentional deception on the part of the owners. The results of the silver discoveries on the Comstock, at Aurora (Esmeralda) and in the Reese River district were so flattering that not a few arrived at the illogical conclusion that all quartz veins must contain silver, and a single piece of ore yielding a high assay value was deemed sufficient to establish the value of a claim. The primary rule "follow the vein" was often disregarded in prospecting, shafts and adits were projected in country rock to cut the veins at depth on the strength of a few pounds of ore taken from the outcrops, or, if the surface material failed to assay, it was argued that in a "true" fissure vein the rich ore would be found at depth. Considerable capital was thus wasted, and much of the work done made less impression on the veins than on the pockets of the men who financed the operations.

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Another common error in judgment by the early miners was the erection of mills before sufficient ore was available or before investigating whether or not the milling process was adapted to the ore. As an illustration - in the Reese River district alone at least 11 mills operated by steam and ranging in size from 5 to 20 stamps were erected prior to 1868. As later work demonstrated, two mills would have sufficed to treat the entire output of the district. However, experience was acquired gradually, and the miners eventually realized that silver mines could not be brought to the productive stage solely by speculation, but only by a combination of capital, economy, and system under the direction of skilled workmen. Although much of the wild excitement and speculation of early mining in Nevada may be deprecated, the net results were beneficial, as numerous important mineral discoveries were made, and the region was explored and opened for settlement.

By 1872, Austin was the second largest town in Nevada in point of numbers and taxable property, ranking next to Virginia City on the Comstock lode.

In 1865, the Manhattan Silver Mining Co. began to consolidate the various mines in the Reese River district, and by 1871 this company controlled nearly all the mines. This consolidation was desirable, as the ore is present in a number of narrow veins cut by faults, and this condition would have caused much litigation if the mines were held by different companies. The Manhattan Silver Mining Co. discontinued operations in 1887, following which several unsuccessful attempts were made to rehabilitate the mines.

The Nevada Central Railroad between Austin and Battle Mountain was built in 1880.

The Battle Mountain district, next in importance to Reese River, was organized in 1866, and by 1870 32 mines were in operation. The principal activity during the seventies and eighties was confined largely to the mining of silver ores. Exploiting of the placer-gold deposits in this area was begun about 1912, and the copper deposits attained considerable prominence during the World War, when they were intensively worked.

Other mining districts of less importance in Lander County include the Lewis and the Bullion, in which the predominant metal is silver. In recent years, mining in Lander County has been characterized by considerable mining under the leasing system, particularly in the districts tributary to the town of Battle Mountain.

Mineral Production

No accurate data are available on the gross production of minerals from Lander County prior to 1902. Production for the Reese River district in the early days is commonly estimated at $40,000,000 to as high as $60,000,000, but such estimates are not substantiated by the data available. The net annual production of gold and silver from 1870 to 1903, as compiled from the quarterly reports of the Lander County assessor for bullion tax

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purposes, is shown in table 1. The amended revenue act of 1867 provided that the value of the ore for tax purposes was to be estimated on the dumps before milling, $18 per ton being deductable on ores treated by the Washoe process (amalgamation without roasting) and $40 per ton on ores treated by the Freiberg process (roasting followed by amalgamation). Revisions of the bullion-tax law in 1871 allowed the mine owners to deduct the actual expenses of mining and reduction. Nearly all the ores produced in Lander County in the early days required roasting which entailed a high reduction cost. Assuming the net value of the ore was 60 percent of the gross, the production of gold and silver from 1870 to 1903, according to table 1, would be about $31,339,000. Of this amount, the Reese River district produced about $22,000,000, the silver deposits in the Galena area of the Battle Mountain district $3,000,000, and the rest was chiefly from the Lewis, Bullion, and Eureka districts. The latter district began production in 1869, and it remained in Lander County until March 1, 1873, when Eureka County was formed. Production for the Eureka district for this period was approximately $3,500,000, which should be credited to Eureka County.

The production of Lander County from 1862 to 1870, not accounted for in table 1, is estimated at $4,000,000, nearly all of which was derived from the Reese River district. According to the original records of the Manhattan Silver Mining Co., the production of bullion up to 1887 was $19,239,033. This company made nearly all the production from the Reese River district from 1870 to 1887. A recapitulation of the estimated total production of gold and silver of Lander County from 1862 to 1903 is as follows:

Reese River district.....	$26,000,000
Battle Mountain district.....	3,000,000
Lewis, Bullion, and other districts.....	1,839,000
	30,839,000

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TABLE 1. - Net annual production of gold and silver from Lander County, 1870-1903

(Compiled from quarterly assessment rolls of the county assessor.)

Year	Tons	Value
1870	11,325	$ 1,104,590.32
1871	25,995	2,099,013.91
1872	40,895	1,871,378.43
1873	23,167	1,569,052.63
1874	6,044	799,829.03
1875	7,133	917,036.65
1876	7,059	882,820.74
1877	5,911	618,905.60
1878	6,746	692,802.76
1879	7,642	784,611.83
1880	4,966	463,619.45
1881	7,036	959,419.05
1882	4,672	749,532.49
1883	5,336	751,696.04
1884	4,100	779,397.76
1885	2,616	582,266.51
1886	4,856	375,994.99
1887	8,581	290,548.93
1888	8,699	158,477.71
1889	23,417	225,410.36
Total	216,196	16,676,405.19

Year	Value of gold	Value of silver	Total value
1890	$ 10,000.00	$ 130,000.00	$ 140,000.00
1891	10,000.00	110,000.00	120,000.00
1892	15,000.00	20,000.00	35,000.00
1893	22,000.00	238,000.00	260,000.00
1894	(No figures given)		
1895	12,548.00	67,028.00	79,576.00
1896	72,144.00	114,420.00	186,564.00
1897	50,046.00	159,860.00	209,906.00
1898	61,075.00	66,039.00	127,114.00
1899	87,170.00	33,000.00	120,170.00
1900	80,075.00	127,190.00	217,265.00
1901	90,212.00	135,207.00	225,419.00
1902	80,650.36	143,273.84	223,924.20
1903	81,550.16	152,327.14	233,877.30
Total	672,470.52	1,496,344.98	2,178,815.50

Year	Tailings tons	Value
1875	20	$ 274.26
1889	8,203	46,389.36
Total	8,223	46,663.62

In addition to gold and silver, small amounts of copper and antimony ores also were produced in the early days. The production of metals in Lander County from 1902 to 1936, had a total value of $11,886,634. This annual production is shown in table 2. Other minerals that have been produced in commercial quantities are antimony, arsenic, barite, and a small amount of turquoise for gem purposes.

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TABLE 2. - Gold, silver, copper, and lead production from Lander County, Nevada, 1902-1936, in terms of recovered metal

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Placer						Lode			
	No. of mines	Gold		Silver		Total value	No. of mines	Ore	Gold	
		Fine ounces	Value	Fine ounces	Value			Short tons	Fine ounces	Value
1902	-	-	-	-	-	-	4	9,538	1,266.54	$ 26,182
1903	-	-	-	-	-	-	3	9,045	1,369.98	28,320
1904	-	-	-	-	-	-	7	1,068	171.35	3,542
1905	-	-	-	-	-	-	7	425	220.64	4,561
1906	-	-	-	-	-	-	8	703	538.27	11,127
1907	-	-	-	-	-	-	10	4,463	4,211.38	87,057
1908	-	-	-	-	-	-	27	1,998	510.45	10,552
1909	-	-	-	-	-	-	15	2,080	1,926.19	39,818
1910	10	272.21	$ 5,627	46	$ 25	$ 5,652	16	12,484	1,735.98	35,886
1911	11	343.07	7,092	67	36	7,128	20	16,170	3,017.50	62,377
1912	9	513.02	10,605	87	54	10,659	32	18,653	3,899.26	80,605
1913	12	1,313.96	27,162	188	113	27,275	35	27,709	3,615.25	74,734
1914	14	4,571.58	94,503	626	346	94,849	15	6,473	972.05	20,094
1915	19	7,777.05	160,766	1,189	603	161,369	23	17,700	1,160.42	23,988
1916	11	7,435.14	153,698	1,050	691	154,389	30	16,099	2,329.88	48,163
1917	33	3,228.84	66,746	460	379	67,125	47	23,848	1,470.11	30,390
1918	6	3,690.00	76,279	490	490	76,769	48	25,432	3,874.35	80,090
1919	8	2,379.23	49,183	319	357	49,540	25	4,863	1,187.99	24,558
1920	5	1,190.89	24,618	176	192	24,810	22	3,730	351.55	7,267
1921	12	3,470.91	71,750	509	509	72,259	18	3,659	1,309.36	27,067
1922	8	2,887.74	59,695	429	429	60,124	10	6,360	181.80	3,758
1923	5	320.20	6,619	44	36	6,655	16	53,286	1,003.63	20,747
1924	6	194.90	4,029	27	18	4,047	15	66,692	1,097.53	22,688
1925	7	193.84	4,007	31	22	4,029	18	65,034	1,233.03	25,489
1926	8	254.74	5,266	36	22	5,288	21	75,349	2,515.07	51,991
1927	7	225.81	4,668	30	17	4,685	25	32,846	1,019.80	21,081
1928	6	303.89	6,282	51	30	6,312	21	37,514	766.65	15,848
1929	3	213.14	4,406	29	15	4,421	25	27,159	1,129.14	23,341
1930	9	204.29	4,223	33	13	4,236	24	9,752	1,531.07	31,650
1931	16	899.29	18,590	115	33	18,623	17	6,748	3,379.58	69,862
1932	9	1,203.56	24,880	165	47	24,927	20	4,667	4,121.94	85,208
1933	17	1,441.17	36,836	234	82	36,918	24	3,765	3,565.68	91,139
1934	27	1,129.36	39,471	174	112	39,583	55	10,725	5,960.97	208,336
1935	22	1,424.58	49,860	219	157	50,017	65	16,332	5,174.31	181,101
1936	23	1,817.00	63,595	231	179	63,774	58	26,092	7,185.00	251,475
Total	-	48,899.41	1,080,456	7,055	5,007	1,085,463	-	648,461	75,003.70	1,830,092

See footnote on page 17

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TABLE 2. - Gold, silver, copper, and lead production from Lander County, Nevada, 1902-1936, in terms of recovered metal (Continued)

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode						Total value	Average recoverable value of ore per ton 1/	Total value (lode and placer)
	Silver		Copper		Lead				
	Fine ounces	Value	Pounds	Value	Pounds	Value			
1902	217,521	$115,286	5,907	$721	12,564	$515	142,704	14.96	$142,704
1903	242,196	130,786	3,100	391	11,620	399	159,896	17.68	159,896
1904	19,664	11,405	3,200	448	112,969	4,510	19,905	18.64	19,905
1905	27,291	16,484	3,000	468	-	-	21,513	50.62	21,513
1906	86,564	57,998	3,404	657	90,506	5,158	74,940	106.60	74,940
1907	143,535	94,733	615,544	123,109	701,312	37,169	342,068	76.65	342,068
1908	52,238	27,686	11,144	1,471	169,857	7,134	46,843	23.44	46,843
1909	61,521	31,991	4,939	642	53,116	2,284	74,735	35.93	74,735
1910	79,086	42,706	11,383	1,446	81,068	3,567	83,605	6.70	89,257
1911	160,613	85,125	6,058	757	66,142	2,976	151,235	9.35	158,363
1912	94,962	58,401	53,341	8,801	239,344	10,770	158,577	8.50	169,236
1913	121,821	73,580	119,640	18,544	121,466	5,344	172,202	6.21	199,477
1914	191,822	106,078	7,772	1,034	66,132	2,579	129,785	20.05	224,634
1915	129,941	65,880	6,760	1,183	76,686	3,604	94,655	5.35	256,024
1916	209,489	137,844	576,493	141,817	199,039	13,734	341,558	21.22	495,947
1917	125,610	103,503	2,480,602	677,204	308,388	26,521	837,618	35.12	904,743
1918	163,779	163,779	2,261,246	558,528	227,971	16,186	818,583	32.19	895,352
1919	73,464	82,280	277,699	51,652	387,370	20,531	179,021	36.81	228,561
1920	60,018	65,419	92,077	16,942	262,045	20,963	110,591	29.65	135,401
1921	25,964	25,964	28,401	3,664	70,844	3,188	59,883	16.37	132,142
1922	85,110	85,110	10,982	1,483	122,107	6,716	97,057	15.26	157,191
1923	896,520	735,146	90,830	13,352	758,625	53,104	822,349	15.43	829,004
1924	946,059	633,860	73,704	9,655	531,919	42,554	708,757	10.63	712,804
1925	975,826	677,223	80,090	11,373	334,302	29,084	743,169	11.43	747,198
1926	1,125,536	702,335	241,271	33,778	465,237	37,219	825,323	10.95	830,611
1927	801,908	454,682	1,367,637	179,161	402,496	25,357	680,281	20.71	684,966
1928	604,102	353,399	3,113,822	448,390	375,791	21,736	839,433	22.38	845,745
1929	234,684	125,087	2,457,290	432,483	135,891	8,561	589,472	21.70	593,893
1930	31,393	12,086	1,316,572	171,154	33,740	1,687	216,577	22.21	220,813
1931	4,143	1,202	142,437	12,962	5,972	221	84,247	12.48	102,870
1932	5,745	1,620	12,466	785	1,952	59	87,672	18.79	112,599
1933	16,335	5,717	62,770	4,017	4,690	174	101,047	26.84	137,965
1934	106,955	69,143	125,170	10,014	69,868	2,585	290,078	27.05	329,661
1935	136,843	98,356	114,711	9,521	68,665	2,747	291,725	17.86	341,742
1936	149,612	115,874	122,000	5,612	338,000	31,096	404,057	15.49	467,831
Total	8,407,870	5,567,768	15,903,462	2,953,219	6,907,694	450,092	10,801,171	16.66	11,886,634

1/ Not to be confused with average assay value of ore.

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BATTLE MOUNTAIN DISTRICT

The Battle Mountain district is in a short, rugged range of the same name in northeastern Lander County. As originally organized, it included all of the Battle Mountain Range, an area about 15 miles long and 12 miles wide bounded by Reese River Valley on the east, Summit Springs Valley on the west, Humboldt Valley on the north, and Buffalo Valley on the south. The district includes a number of mining camps, the more prominent of which are Copper Canyon, Copper Basin, Galena, Iron Canyon, and several others of less importance. The town of Battle Mountain, near the junction of the Reese and Humboldt Rivers, is the supply center and shipping point. The town is served by the Southern Pacific and Western Pacific Railroads.

The first mineral discovery in the Battle Mountain Range was copper ore and was made by Shoshone Indians. In 1866 Sinclair, Pickett, Heath, and others located a number of copper claims, among them the Virgin, Mary Louise, and Troy (now part of the Copper Canyon Mining Co. holdings). The district was organized the same year and called Battle Mountain, from a battle fought in the vicinity in 1857 between a large force of Shoshone Indians and a Government expedition under the command of John Kirk, which was engaged in surveying the Fort Kearney wagon road, Pacific Division.

According to early reports of the Nevada State mineralogist, the Little Giant silver mine was located in 1867 and the silver deposits at Galena shortly after. By 1870, 33 mines were in operation, and two smelters of 12 and 20 tons capacity, respectively, were built at Galena.

About 1868 the copper mines were acquired by an English company called the Battle Mountain Mining Co., and for a number of years hand-sorted copper ores and concentrates were shipped to Swansea, Wales, via train to the Pacific coast and thence in sailing vessels around the Horn to England. The ore was carried as ballast, and the cost of freight from the mines to England was $35 per ton.

In 1875, the Battle Mountain Mining Co. erected a 30-ton concentrator at Willow Creek, about 3 miles from the Copper Canyon mine. The ore was crushed in a Blake-type crusher and further reduced by wet Cornish rolls. The crushed ore was separated by screening into five different sizes, and the various products were concentrated in jigs hand-operated by Chinese.

The copper mines were inactive from 1885 until 1897, when they were acquired by the Glasgow Western Exploration Co., controlled by J. & P. Coates, the thread manufacturers. This company made a small production for several years to supply its smelter at Golconda, Nev. About 1910, the company erected a leaching plant at Copper Canyon to treat the low-grade oxidized copper ores, but it was metallurgically unsuccessful, as an extraction of only 47 percent was obtained. In 1914 the Glasgow & Western Co. shut down, and in 1916 the Copper Canyon Mining Co. was formed to take over the Copper Canyon mines. In 1917 this company acquired additional mineral acreage in the Copper Basin area.

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During the World War, under the stimulus of high prices for copper, the Copper Canyon Mining Co. produced and shipped considerable quantities of ore from the Copper Canyon and Copper Basin mines. From 1918 to 1935 the copper mines were worked sporadically, chiefly by lessees.

In 1932 gold was discovered in the Copper Canyon mine by Robert Wigglesworth, a lessee, while panning for native copper. This discovery, combined with the increased price for gold, stimulated further prospecting by lessees, who shipped considerable ore. In 1935, the Copper Canyon Mining Co. began a development campaign, which has been so successful that the mines are in a better position today, so far as ore reserves are concerned, than at any time in their history.

From time to time small booms have occurred in the district owing to discoveries of high-grade ore. In 1909, high-grade gold-bearing quartz was discovered by Alexander Walker in the Bannock area, 14 miles southwest of Battle Mountain, and a short-lived boom ensued. Another gold strike was made late in 1910 by J. Hutchins at the head of Willow Creek, but after a brief rush the camp of Telluride, as it was named, was virtually abandoned.

Placer-gold deposits were discovered about 1912 at the mouth of Copper Canyon and were worked intensively for a number of years thereafter. About the same time, placer deposits were discovered in other parts of the Battle Mountain Range, including Box, Philadelphia, Iron, and Long Canyons. All of these have been worked intermittently to the present time, largely by hand methods.

No accurate statistics are available on the production of metals from the Battle Mountain district prior to 1902. It is estimated, however, that up to 1902 the Little Giant, Buena Vista, White and Shiloh, Trinity, and Avalanche silver mines and the Copper Canyon copper mine produced metals having a total value of $3,000,000. Small quantities of antimony also were produced from the mines in Cottonwood Canyon in the early days. From 1922 to 1924 the Irish Rose mine operated steadily in the production of arsenic ore, which was shipped to a white-arsenic plant at Toulon, Nev.

The production of metals from 1902 to 1936 was $5,164,747 in copper, gold, silver, and lead, the bulk of which was made by lessees. Statistics on annual production from 1902 to 1936, inclusive, are shown in table 3.

Production of turquoise in the district was begun in 1937.

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TABLE 3. - Gold, silver, copper, and lead production from Battle Mountain district, Lander County, Nevada, 1902-1936, in terms of recovered metal

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Placer						Lode			
	No. of mines	Gold		Silver		Total value	No. of mines	Ore	Gold	
		Fine ounces	Value	Fine ounces	Value			Short tons	Fine ounces	Value
1902	-	-	-	-	-	-	1	75	-	-
1903	-	-	-	-	-	-	1	625	251.55	$5,200
1904	-	-	-	-	-	-	7	1,068	171.35	3,542
1905	-	-	-	-	-	-	3	85	55.34	1,144
1906	-	-	-	-	-	-	-	-	-	-
1907	-	-	-	-	-	-	2	1,452	65.93	1,363
1908	-	-	-	-	-	-	6	432	220.83	4,565
1909	-	-	-	-	-	-	5	347	764.57	15,805
1910	10	272.21	$5,627	46	$25	$5,652	5	11,745	1,334.74	27,592
1911	10	268.06	5,541	47	25	5,566	7	12,540	1,206.43	24,939
1912	9	513.03	10,505	87	54	10,659	10	732	413.45	8,547
1913	12	1,313.96	27,162	188	113	27,275	15	546	169.98	3,514
1914	14	4,571.58	94,503	626	346	94,849	3	55	14.90	308
1915	17	7,768.84	160,596	1,187	602	161,198	6	135	89.38	1,848
1916	11	7,435.15	153,698	1,050	691	154,389	13	4,334	259.80	5,371
1917	33	3,228.85	66,746	460	379	67,125	20	18,162	236.09	4,880
1918	6	3,689.99	76,279	490	490	76,769	23	15,845	433.11	8,953
1919	8	2,379.25	49,183	319	357	49,540	9	3,544	88.73	1,834
1920	5	1,190.89	24,618	176	192	24,810	5	2,678	174.41	3,605
1921	12	3,470.91	71,750	509	509	72,259	3	947	205.50	4,248
1922	8	2,887.72	59,694	429	429	60,123	5	1,291	112.01	2,315
1923	5	320.19	6,619	44	36	6,655	6	5,620	390.37	8,070
1924	5	191.44	3,957	26	17	3,974	8	5,032	330.98	6,842
1925	7	193.83	4,007	31	22	4,029	6	641	369.43	7,637
1926	8	254.74	5,266	36	22	5,288	8	913	197.83	4,090
1927	6	224.12	4,633	28	16	4,649	13	5,738	398.77	8,243
1928	5	303.91	6,282	51	30	6,312	15	15,608	364.10	7,527
1929	3	213.14	4,406	29	15	4,421	19	15,696	582.51	12,042
1930	9	204.31	4,223	33	13	4,236	15	7,236	318.87	6,592
1931	14	885.73	18,310	113	32	18,342	8	1,037	842.74	17,421
1932	7	1,147.91	23,729	159	45	23,774	7	1,276	2,226.82	46,032
1933	13	1,362.78	34,833	223	78	34,911	16	2,939	3,271.48	83,619
1934	21	914.85	31,974	152	98	32,072	30	7,213	4,330.63	151,356
1935	10	1,009.88	35,346	173	124	35,470	33	8,207	3,880.65	135,823
1936	10	1,415.53	49,544	188	146	49,690	29	9,585	3,399.32	118,976
Total	-	47,632.80	1,039,131	6,900	4,906	1,044,037	-	163,379	27,172.60	743,843

See footnote on page 21.

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TABLE 3. - Gold, silver, copper, and lead production from Battle Mountain district, Lander County, Nevada, 1902-1936, in terms of recovered metal (Continued)

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode								Total value (lode and placer)
	Silver		Copper		Lead		Total value	Average recoverable value of ore per ton 1/	
	Fine ounces	Value	Pounds	Value	Pounds	Value			
1902	2,880	$1,526	-	-	-	-	$1,526	$20.35	$1,526
1903	94,183	50,859	-	-	1,120	$49	56,108	89.77	56,108
1904	19,664	11,405	3,200	$448	112,969	4,510	19,905	18.64	19,905
1905	4,970	3,002	3,000	468	-	-	4,614	54.28	4,614
1906	-	-	-	-	-	-	-	-	-
1907	8,645	5,706	287,300	57,460	22,210	1,177	65,706	45.25	65,706
1908	10,922	5,789	-	-	96,357	4,047	14,401	33.34	14,401
1909	9,248	4,809	354	46	6,930	298	20,958	60.40	20,958
1910	51,694	27,915	4,558	579	8,804	387	56,473	4.81	62,125
1911	56,721	30,062	3,791	474	35,029	1,576	57,051	4.55	62,617
1912	11,137	6,849	39,520	6,521	99,940	4,497	26,414	36.08	37,073
1913	13,722	8,288	116,574	18,069	28,134	1,238	31,109	56.98	58,384
1914	4,830	2,671	-	-	10,804	421	3,400	61.82	98,249
1915	1,345	682	1,920	336	20,060	944	3,810	28.22	155,008
1916	40,310	26,524	566,890	139,454	87,166	6,015	177,364	40.92	331,753
1917	18,595	15,322	2,431,247	663,730	98,978	8,512	692,444	38.13	759,569
1918	43,480	43,480	1,999,040	493,763	68,894	4,891	551,087	34.78	627,856
1919	14,884	16,670	254,860	47,404	50,145	2,658	68,566	19.35	118,106
1920	14,875	16,214	90,135	15,585	226,297	18,104	54,508	20.35	79,318
1921	2,728	2,728	103	13	12,834	578	7,557	7.99	79,826
1922	8,436	8,436	6,393	853	63,019	3,466	15,080	11.68	75,203
1923	56,368	46,222	34,344	5,049	436,006	30,520	89,861	15.99	96,516
1924	37,550	25,159	39,852	5,221	289,313	23,145	60,367	12.00	64,341
1925	2,439	1,692	504	72	3,913	340	9,741	15.20	13,770
1926	5,172	3,228	153,172	21,444	54,221	4,338	33,100	36.25	38,388
1927	5,989	3,396	1,312,871	171,986	47,140	2,970	185,595	32.52	191,244
1928	32,380	18,942	3,075,242	442,835	138,223	8,017	477,321	30.58	483,633
1929	28,161	15,010	2,431,614	427,964	46,500	2,929	457,945	29.18	462,366
1930	7,307	2,813	1,304,984	169,648	25,259	1,263	180,316	24.92	184,552
1931	2,100	609	138,712	12,623	4,045	150	30,803	29.70	49,145
1932	4,387	1,237	10,566	665	517	16	47,950	37.58	71,724
1933	9,069	3,174	59,000	3,776	3,064	113	90,682	30.85	125,593
1934	35,984	23,262	72,157	5,773	39,905	1,476	181,867	25.21	213,939
1935	41,996	30,185	66,363	5,508	33,983	1,359	172,875	21.06	208,345
1936	36,194	28,032	254,268	23,393	60,759	2,795	173,196	18.07	222,886
Total	738,365	491,898	14,762,534	2,742,170	2,232,538	142,799	4,120,710	25.22	5,164,747

1/ Not to be confused with average assay of ore

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Copper Canyon Mining Co.

The Copper Canyon Mining Co., Herman Aaron, New York City, president, owns a large acreage of patented and unpatented claims at Copper Canyon and Copper Basin in the Battle Mountain district. Copper Canyon, at the southwest end of the Battle Mountain Range, is 12 miles southwest of Copper Basin.

Copper Canyon mine is developed by the Virgin shaft, 630 feet deep, inclined about 65°, with levels established at the 113, 188-, 260-, 330-, 470-, 530-, and 590-foot stations, measured on the dip of the shaft. Workings aggregate about 4,000 feet. The Copper Basin area has been explored by at least six vertical shafts, the deepest about 300 feet, and several adits, which with subsidiary and other scattered workings total approximately 3 miles.

The equipment at the Copper Canyon mine comprises a 40-horse power Fairbanks-Morse geared hoist, 2 Ingersoll-Rand single-stage compressors driven by Waukesha 75-horse power distillate engine, blacksmith shop, and various mining tools. At Copper Basin several of the shafts are equipped with Fairbanks-Morse geared hoists, portable compressors, and other mining tools. Both properties are equipped with camp accommodations for large crews of men.

In recent years the principal production has been made by lessees. Usually leases are given for 1 year, with the privilege of extension for another year, such extension subject to termination by either party on 90 days' notice. The lease contract usually calls for a minimum of 100 man-shifts of labor each month for the term of the lease. Royalties paid per dry ton, after deduction of freight and treatment charges (public sampling, inspection of sampling, and assaying classified as treatment charges) are as follows:

Value of ore per ton	Royalty per ton
$40 or less	15 percent
$40 to $50	15 percent plus $1
$50 to $60	15 percent plus $2
$60 to $70	15 percent plus $3
$70 or more	15 percent plus $4

At the Copper Canyon mine the prevailing rocks are quartzite and argillaceous shales intruded by monzonite porphyry. The general strike of the sedimentary strata is N. 15° to 20° W., with a dip of 15 to 20 percent southwesterly. The Superior and Virgin fissure veins are 300 feet apart and strike about north and south with a dip of 65° westerly. There is also a system of mineralized cross fissures with a general northwest-southeast strike and easterly dip; the principal one, the Estes, strikes N. 28° W. and dips N. 80° E. Formerly, activity was confined largely to mining oxidized copper ores in the Superior, Virgin, and Estes veins. The gold-bearing zone has a length of about 400 feet and a width of 80 feet and lies between the Virgin fault on the west and the recently discovered Gulch fault on the east. The latter fault has about the same strike and dip as the Superior and Virgin. According to the annual report of the company, dated February 1, 1938, the developed tonnage of gold-copper ore in the Copper Canyon mine above the 330-foot level of the Virgin shaft was 466,000 tons, with 182,000 tons of probable

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ore containing an average of 1.19 percent copper, 0.204 ounce gold, and 1.46 ounces silver per ton. In addition, about 100,000 tons of 2-1/2-percent copper ore is available in the old stope fills and pillars. The gold occurs as siliceous oxidized ore, oxidized-sulphide gold-copper ore, and sulphide gold-copper ore. In the oxidized zone the copper minerals are malachite, azurite, cuprite, chalcocite, chrysocolla, native copper, and chalcanthite; and in the sulphide zone they are chalcopyrite and bornite associated with pyrite and pyrrhotite.

At the Copper Basin property the formation consists principally of quartzitic shales and argillaceous sandstones and shales intruded by granite porphyry dikes. Secondary copper ores have been mined, principally by lessees, from a number of apparently disconnected deposits in an area covering several square miles. The primary mineralization is extensive, but the copper content is only 0.3 percent. The secondary ore is composed of copper carbonates and disseminated sulphides, chiefly chalcocite. The copper carbonate ore extends but a short distance below the surface, and at a slightly lower depth the chalcocite ores occur. The high-grade ore mined by lessees occurs in pockets surrounded by lower-grade material. The smelter returns on a carload of chalcocite ore mined by George Govich (lessee) from the Contention workings and shipped to the International Smelting & Refining Co. on November 27, 1937, furnished the following data:

Metal quotations: Gold $34.910 per ounce.
Copper 11.775 cents per pound, average for week ended 10/27/37

Settlement assay:	Ounce per ton
Gold	0.02
Silver	.165
	Percent
Copper	7.54
Insoluble	75.2
Iron	5.0
Sulphur	7.1
Lime	nil

Treatment charge:		
Base charge		$2.50
Credit (Utah Ore Sampling Co.) sampling		.25
Treatment charge		2.25

	Pounds
Wet weight	111,200
Moisture 3.25 percent	3,614
Dry weight	107,586 or 53.793 tons

Metal payment:		
Gold, 100 percent at $31.816 per ounce		$0.636
Copper, less 15 pounds at $0.09275 per pound		12.595
Gross metal payment		13.231
Treatment charge		2.25
Net value per ton		10.981
53.793 tons at $10.981		590.70

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Deductions:	Freight at $3.00 per ton	$166.80	
	Hauling at $1.00 per ton	55.60	
	Utah Ore Sampling Co., sampling	33.36	
	Assaying	4.00	
	Umpire assaying	3.00	
	Royalty, 15 percent of $383.54	57.53	
		320.29	
			320.29
	Net proceeds		270.41

Gold ores have also been mined and shipped from the Copper Basin property in recent years, the principal production being made by Ernest Johnson and A. T. Dolezal from a lease on the Carrissa and Pedro claims. From April 1936 to April 1938 the lessees had shipped about 115 cars of ore averaging about $30 per ton. The gold is in an irregular deposit in a shale formation, and the ore was taken from a depth of not more than 50 feet. The smelter returns on a representative carload shipped to the International Smelting & Refining Co October 29, 1936, were as follows:

Metal quotations:	Gold	$34.910 per ounce
	Silver	.4475 per ounce
	Copper	9.525 cents per pound
		Ounces
Settlement assay:	Gold	.90
	Silver	4.39
		Percent
	Copper	7.675
	Lead	Nil
	Insoluble	48.5
	Iron	13.6
	Sulphur	Trace
	Lime	7.6

	Pounds
Wet weight	117,520
Moisture 16.7 percent	19,626
Dry weight	97,894 or 48.947 tons

Metal payment:	Gold, 100 percent at 31.816 per ounce		$ 28.634
	Silver, less 1/2 ounce at $0.4475		1.741
	Copper, less 15 pounds at $0.07 per pound		9.695
	Gross value per ton		40.070
	Treatment charge		4.004
	Net value per ton		36.066
	48.947 tons at $36.066		1,765.32
Deductions:	Sampling, Utah Ore Sampling Co.	$35.98	
	Assaying	4.00	
	Hauling $1.50 per ton	89.94	
	Freight at $4.40 per ton	263.82	
	Royalty, 15 percent of $1,497.79	224.67	
		618.41	618.41
	Net proceeds		1,146.91

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With reference to the ore reserves at the Copper Basin mine, a report by the company geologist, L. S. Breckon, dated January 9, 1938, states in part as follows:

> It is evident there was approximately 760,000 tons of 2.33-percent copper ore developed in the old workings at the end of the operations in 1923. However, since that time lessees have shipped, up to January 1, 1929, about 15,000 tons of the higher-grade ore, and since then the figures on the tonnages shipped are not available, although I presume it has not been large. In the yearly report of 1923 there is shown a total tonnage of 57,200 tons that averages 6.68 percent copper and this the lessees have been mining since the calculations were made. Therefore, the tonnage remaining, I should say, will be 35,000 tons of this grade of ore.
>
> At the Carrissa No. 1 claim, now being worked by the Johnson-Dolezal lease, there is approximately 20,000 tons averaging 0.30 ounce of gold, available for a mill. At several places to the northeast are small tonnages of gold ore in sight but no definite tonnage blocked out.

Tomboy Group

The Tomboy group of two unpatented claims, owned by D. F. Shovelin of Battle Mountain, Nev., is at the head of Box Canyon about 15-1/2 miles southwest of Battle Mountain, the nearest shipping point. This property was located by Lyman Sands and William Gibson in about 1900, and although it was worked intermittently for a number of years, no production was obtained until 1926, when Lyman Sands and associates erected a 35-ton Denver quartz mill with amalgamation equipment on the flat several miles southeast of the mine. This mill operated for about 7 months and treated nearly 4,000 tons of ore. Subsequently the property was acquired by Shovelin; it has been worked intermittently by lessees, who made sporadic shipments of ore to Utah smelters. In April 1938 the property was under lease to Jerry Paul and Clyde Herbert, who were engaged in the production of shipping ore.

Development consists of several adits and shallow shafts, which with scattered surface workings total about 600 feet. The only equipment on the property is a blacksmith shop and tools for hand mining.

The prevailing country rock is indurated sandstone striking nearly north and south and dipping westward at low angles. The ore occurs in a shear zone striking nearly north and south and dipping eastward across the bedding of sandstone. The mineralized zone has been exposed by adits and surface workings for several hundred feet. At the north end the ore is brecciated and stained with iron oxides. Former operations on oxidized ore were centered around a glory hole roughly 75 feet long, 25 feet wide, and about 35 feet deep. The gold is chiefly in the free state. At the south end of the zone, sulphide ore is exposed in two adits respectively 30 and 50 feet in length and about 60 feet apart. In each of the adits disseminated sulphide ore

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consisting mainly of pyrite carrying gold has been exposed over an average width of 25 feet. Four carloads of sulphide ore ranging from $6 to $17 per ton in value have been shipped. The smelter returns on a carload shipment made by Jerry Paul to the American Smelting & Refining Co. on May 17, 1937, furnished the following data:

Metal quotation:	Gold	$34.9125 per ounce		
		Ounce		
Settlement assay:	Gold	0.345		
	Silver	.45		
		Percent		
	Copper	0.375		
	Insoluble	64.8		
	Sulphur	8.8		
	Arsenic	.7		
	Iron	14.8		
	Antimony	.2		
	Pounds			
Wet weight	107,360			
Moisture 2.5 percent	2,684			
Dry weight	104,676 or 52.338 tons			
Metal payment:	Gold 100 percent at $31.81825 per ounce			$10.98
	Treatment charge			3.75
	Net value per ton			7.23
	52.338 tons at $7.23			378.40
Deductions:	Freight at $3.20		$171.78	
	Hauling at $1.50		80.52	
	Assaying		3.50	
	Royalty, 15 percent		18.39	
			274.19	274.19
	Net proceeds			104.21

Considering the small amount of work done on the sulphide ore, the showing is very encouraging for the development of enough tonnage for a milling proposition.

Buzzard Mine

The Buzzard mine comprises the Buzzard, Cyclone, and Republic patented claims, owned jointly by the Gold Deposit Mining Co. and J. W. Leach of Battle Mountain, Nev. It is situated on the crest of a mountain spur south of Iron Canyon about 2 miles southeast of the old camp Galena and 13 1/2 miles southwe of Battle Mountain, the nearest shipping point. It formerly constituted a part of the Iron Canyon group of claims owned by the Iron Canyon Gold Mining Co.

The Buzzard vein was discovered sometime in the eighties and was actively worked for a number of years following its discovery. No statistics are

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available on early production, but judging from the amount of stoping and the high grade of the ore mined it is safe to assume that the property has produced more than $200,000. About 1910 the property was worked by the Gold Canyon Mining Co., and the ore was treated in a small 20-ton cyanide leaching plant at the mouth of Galena Canyon, several miles from the mine. The size of the tailings pile near the old mill site indicates that at least several thousand tons of ore were treated. In recent years the mine has been worked intermittently by lessees. In 1932 the mine was leased to C. A. and W. L. Leach, who up to April 1938 had produced 15 cars of ore having a gross smelter value of about $25,000.

The mine is developed by an adit reported to be 800 feet in length, several shafts, and a number of open-cuts totaling about 2,000 feet. The adit level is about 120 feet below the highest point of the outcrop. From this level the winze has been sunk 75 feet, and this winze is the deepest working in the mine. Equipment includes a one-drill Ingersoll-Rand portable compressor, a jack hammer, and a hand-operated windlass hoist.

The prevailing formation in the vicinity of the mine is a fine-grained quartzite. The Buzzard vein strikes nearly north and south and dips 65° to 80° westward. It ranges in width from a few inches to a maximum of 8 feet, averaging about 3 feet. Gold and silver ore occurs in short shoots that parallel the dip of the vein. The vein has been opened on the surface over a length of about 800 feet. The gold and silver occur in a gangue of soft porous limonitic material and quartz in the oxidized zone. The shipping ore contained an average of 12 ounces in silver to each ounce of gold. At the south end of the vein the ore is a hard, quartzose material containing pyrite and chalcopyrite and their oxidation products. The copper content increases and the gold decreases at depth. The average value of the ore near the surface ranges from $12 to $15 per ton, but by selective mining and hand-sorting the value of the shipping product is increased from $80 to $150 per ton. The smelter returns on a shipment of ore made by C. A. Leach to the American Smelting & Refining Co. on May 20, 1936, furnished the following data:

Metal quotations:	Gold	$34.9125 per ounce
	Silver	.77 per ounce
	Copper	9.15 less 2.525 cents per pound
		Ounces
Settlement assay:	Gold	3.255
	Silver	36.575
		Percent
	Copper	0.76
	Arsenic	2.1
	Antimony	.2
	Pounds	
Wet weight	38,420	
Weight 242 sacks	140	
	38,280	
Moisture 7.65 per cent	2,928	
Dry weight	35,352	or 17.676 tons

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Treatment charge:	Base charge	$2.50	
	10 percent excess over $20 gross value, maximum	3.00	
		5.50	
	Arsenic and antimony penalty	.17	
	Treatment charge per ton	5.67	
Metal payment:	Gold, 100 percent at $32.31825 per ounce	$105.20	
	Silver, 95 percent at $0.77 per ounce	26.75	
	Copper, less 75 percent at $1.325 per unit of 20 pounds	.01	
	Gross value per ton	131.96	
	Treatment charge	5.67	
	Net value per ton	126.29	
	17.676 tons at $126.29		$2,232.30
Deductions:	Freight	163.53	
	Emergency freight, 7 percent	11.45	
	Sledding	30.00	
	Hauling at $3.50	67.24	
	Assaying	9.00	
	Sampling	21.20	
		302.42	302.42
			1,929.88
	Royalty, 20 percent net		385.98
	Net proceeds		1,543.90

The ore is skidded down a steep trail by horse-team and stone-boat for about one-third mile to the ore bin in Philadelphia Canyon. The cost of team-hauling is $2 per ton. Truck-haul to Battle Mountain, a distance of about 15 miles, costs $3.50 per ton. The royalties paid on the net smelter returns are 12-1/2 percent on ore assaying $50 or less, 15 percent on ore from $50 to $100, and 20 percent on ore valued at more than $100 per ton.

Gold Butte Group

The Gold Butte group, one placer and six lode claims, unpatented, owned by R. M. Oliver of Battle Mountain, is in Butte Canyon (also known as Plumas Canyon) about 1/2 mile above the junction of Butte with Galena Canyon. Battle Mountain, the nearest shipping point, is 14 miles northwest. This property was first worked from 1866 to 1872, during which period ore valued at more than $100,000 is reported to have been produced. In 1872 the property closed because of litigation, and eventually the claims reverted to the public domain. It remained virtually inactive until 1934, when the claims were relocated by the present owner. In the early days the ores were treated by pan amalgamation and the remains of the old mill can still be seen at the mouth of Butte Canyon. The extraction by this process evidently was very poor, since the tailings were shipped to smelters later. Oliver, working alone, has mined and shipped

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seven carloads of silver ore, ranging in value from $14 to $25 per ton, since 1934. There is no mining equipment on the property other than hand tools.

Development consists of two adits and several shafts, which, with subsidiary workings, total 1,600 feet. The deepest working is 280 feet from the surface.

There are two veins on the property; in one silver is the important economic mineral and in the other, gold. Very little work has been done on the gold vein and no production has been made. The prevailing formation is silicified shale intruded by cupolas of monzonite. The silver vein on which most of the work has been done strikes N. 10° W. and dips 45° to 60° westerly. This vein parallels the bedding of the shale and has been explored for several hundred feet. The width of the vein ranges from 1 to 9 feet, averaging about 3 feet. The value of the ore ranges from $6 to $12 per ton. The ore that is economical to ship occurs in seams from 6 to 14 inches in width within the vein material, but such seams are not continuous. The workings are largely in the oxidized zone, and the silver minerals are chiefly cerargyrite and argentite. Oxidized copper minerals, lead in the form of cerussite, and arsenical compounds are associated with the ore. A carload shipment of ore in two separate lots was made by R. M. Oliver to the American Smelting & Refining Co. on January 10, 1938; the smelter returns on the lot of lowest value were as follows:

Metal quotations:	Gold	$34.9125 per ounce	
	Silver	.77 per ounce	
	Lead	4.75 less 3.50 cents per pound	
		Ounces	
Settlement assay:	Gold	0.0775	
	Silver	19.25	
		Percent	
	Lead	3.1	
	Copper	.1	
	Insoluble	71.5	
	Sulphur	1.3	
	Arsenic	.65	
	Iron	12.7	
	Antimony	.2	
	Pounds		
Wet weight	57,380		
Moisture 2.5 percent	1,434		
Dry weight	55,946 or 27.973 tons		
Metal payment:	Gold, 100 percent at $31.81825 per ounce		$ 2.47
	Silver, 95 percent at $0.77 per ounce		14.08
	Lead, less 50 percent at $.25 per unit		.39
	Gross value per ton		16.94
	Smelting charge		3.60
	Net value per ton		13.34
	27.973 tons at $13.34		373.16

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Deductions:	Freight at $3.20 per ton	$91.81	
	Switching	1.35	
	Team-hauling at $1 per ton	28.69	
	Trucking at $2 per ton	57.38	
	Assaying	3.50	
		182.73	182.73
	Net proceeds		190.43

Peggy Group

The Peggy group of four unpatented claims owned by Mrs. Imogene Vail of Battle Mountain is in Long Creek Canyon several miles north of the Copper Basin Camp and 10 miles west of Battle Mountain. According to a location notice on one of the claims, the property was located by Jasper Vail in 1916. It has been worked intermittently by lessees for shipping ore; the principal production was made in 1935 by J. M. Wigglesworth, who shipped 458 tons having a gross smelter value of $6,755.66, an average of $14.74 per ton.

Development consists of an adit about 200 feet long, several shafts each about 40 feet deep, and other scattered surface workings totaling about 500 feet. The deepest working is probably about 50 feet from the surface. There is no equipment on the property. In April 1938 the property was idle.

The prevailing formation in the vicinity is shale and quartzite. Ore occurs in a steeply dipping irregular fissure vein that ranges in width from 6 inches to 3 feet. The best ore occurs where the vein has been cut by cross fractures.

The ore consists of quartz and talcy material stained with iron and manganese oxides and containing silver and minor amounts of gold. The smelter returns on a carload of ore shipped by J. M. Wigglesworth to the American Smelting & Refining Co. on March 16, 1935, furnished the following data:

Metal quotations:	Gold	$34.9125 per ounce
	Silver	.64125 per ounce
		Ounces
Settlement assay:	Gold	0.1425
	Silver	18.33
		Percent
	Copper	0.20
	Insoluble	38.8
	Sulphur	.4
	Arsenic	.85
	Iron	5.6
	Antimony	.35
	Calcium oxide	.8
		Pounds
Wet weight		106,100
Moisture 7.9 percent		8,380
Dry weight		97,720 or 48.86 tons

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Smelter payment	Gold, 100 percent at $31.81825 per ounce	$4.53	
	Silver at $0.64125 per ounce	11.75	
		16.28	
	Treatment charge	3.60	
	Net value per ton	12.68	
	48.86 tons at $12.68 per ton.....		619.53
Deductions:	Freight at $3.20 per ton	$169.73	
	Hauling at $2.00 per ton	106.08	
	Watching	4.00	
	Assaying	3.00	
		282.81	282.81
	Net proceeds		$336.72

Royalty paid on the foregoing shipment amounted to 10 percent of the net smelter returns.

Iron Canyon Placer

Iron Canyon, a tributary of Galena Canyon, is in the southeast portion of the Battle Mountain Range about 12 miles southwest of the town of Battle Mountain. Placer gold was found here in 1913. The canyon has been worked intermittently by drift mining and with small-scale placer equipment, chiefly sluices and rockers. Water for concentration is obtained from melting snows during the spring run-off. No accurate figures are available on the production of gold, but it has been in the neighborhood of $15,000. In April 1938 three men were engaged in placer mining in this area. The ground is held by various individuals.

Iron Canyon is V-shaped and about 2 miles in length; the floor averages less than 100 feet in width. The alluvium ranges from 15 to 30 feet in depth, and the gold is concentrated largely in the 6 feet of gravel directly above bedrock. The top portion of the alluvium consists of fine gravel and soil and the bottom part of rock fragments with a few large boulders. The bedrock is principally shale. Gold is sharp, angular, and local in origin. Nuggets up to $10 in value have been found. Considerable barite is associated with the gold. During the spring of the year drift mining is hampered by a large flow of water along bedrock.

Iron Canyon joins Galena Canyon a short distance from the mouth of the latter, and although some prospecting has been done in Galena Canyon above the junction point, no placer gold has been found. Below the junction point, however, several shafts have been sunk, and in places good values in gold are reported. Here the alluvium is much coarser than in Iron Canyon and consists chiefly of boulders. Small-scale placer-mining activity in this area is hampered by a large subsurface flow of water.

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Plumas Group

The Plumas group of three patented and two unpatented claims, owned by E. O. Swackhammer of Battle Mountain, is in Butte Canyon, a tributary of Galena Canyon, about 3/4 mile south of the old camp of Galena and 15 miles southwest of Battle Mountain. This property has been worked sporadically for shipping ore for a number of years; it was last active in 1934 when a small stock company shipped about 18 carloads of ore. According to Swackhammer, the production has been about 800 tons of ore averaging $20 per ton. In April 1938 the property was under option to the San Miguel-Nevada Mines, Ltd., but it was inactive.

Development consists of an adit about 200 feet long, a shaft, and other workings totaling about 1,000 feet. There is no usable mining equipment on the property.

The prevailing formation in the vicinity is sandstone overlain by shale. Mineralization occurs in a crushed zone in sandstone. This zone strikes nearly north and south and dips about 60° westerly, with a width ranging from 3 to 6 feet and averaging about 4 feet.

The ore consists of a gold-bearing gangue of crushed country rock and quartz impregnated with iron oxides.

Acacia Hawkeye Group

The Acacia Hawkeye group, owned by Mrs. Imogene Vail of Battle Mountain, Nev., comprises 18 unpatented claims in the Copper Basin area, 9 miles a little south of west from Battle Mountain. It adjoins the Copper Canyon Mining Co. holdings on the west. Early in 1938 the property was taken over under bond-and-lease agreement by George Govich, T. E. Wood, and associates, of Battle Mountain.

Originally the claims were located for lode deposits, but the principal production has been derived from placers discovered in 1913 by Jasper Vail as a result of prospecting stimulated by the discovery of the Dahl and Christensen placer at the mouth of Copper Canyon. Following Vail's discovery, the ground was leased in small blocks to individuals at a royalty of 20 percent of the gold recovered. Small-scale equipment, such as rockers and dry washers, was employed for recovering the gold. In some years, when enough water could be obtained from the spring run-off, ground sluicing was employed, the water being diverted from Long Creek and brought to the ground in a ditch dug by hand. The total production of placer gold has probably been more than $75,000. In 1937, 93.28 ounces of gold was produced, with a total value of $2,922.36, according to the mint returns. The property has also produced about 1,000 tons of copper ore and 100 tons of gold ore.

Development on the placer deposits consists of several hundred shafts and open-cuts ranging from 5 to 30 feet in depth. A number of the shafts are interconnected by drifts driven along bedrock. The lode deposits have been

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prospected by several shafts, a long adit, and other underground workings totaling about 1,000 feet. At the time of the writer's visit there was no mining equipment on the property, but preparations were being made to prospect the lode and placer deposits by trenching with a power shovel.

Placer gold has been found along Vail Gulch for a length of nearly 1-1/2 miles and in several side gulches tributary to Vail Gulch. The gravel consists of a mixture of angular fragments and sand, in places loosely cemented. The average depth of the alluvium is about 10 feet. The gold is all local in origin and occurs in scalelike particles. The largest nugget found weighed 3 ounces. Bedrock is silicified shale and monzonite. The gold is found principally next to the bedrock. If enough water could be obtained at a reasonable cost it is probable that the gold content of gravel and yardage available would justify the installation of a dragline and washing plant. Considering the manner in which the placer has been worked in the past, it appears that the material near bedrock must have averaged about $5 per cubic yard.

Dahl and Christensen Placer

The Dahl and Christensen placer is at the mouth of Copper Canyon on the south slope of the Battle Mountain Range about 18 miles southeast of Battle Mountain. This property comprises about 2,600 acres and a water right on Willow Creek about 3 miles distant. Placer gold was discovered here in 1913 by James Dahl in partnership with H. C. Christensen, of Battle Mountain. A short time after the discovery as many as 90 men were employed by Dahl and Christensen to drift-mine the placer channels; the gold was recovered by hand rockers. With the exhaustion of the richer gravel, the property was taken over by Dudley Wilson and associates of Battle Mountain, who worked with a dragline and sluice for a number of seasons. In 1935 the placer was acquired by a group of men from Oklahoma City, Okla., who organized the Grand Hills Mining Co. This company installed a mechanical washing plant equipped with trommel and Ainlay-bowl concentrators; mining was done with power shovel. After operating about 1 year, the company discontinued operations. In recent years the placer has been worked by lessees, who drift-mine the channels and recover the gold in side-shaking power sluice boxes. In April 1938, 10 lessees were working, generally with fair returns.

The Battle Mountain placers produced $1,044,037 from 1910 to 1936, most of it from the Dahl and Christensen placer. From May 1936 to November 1, 1937, production by lessees was $27,000.

Development includes an adit 2,300 feet long, 1,600 feet of which was driven in gravel before the channels were come upon, a number of shafts, and other workings totaling probably more than 1 mile. Three separate channels are worked by lateral drifts from the main adit. Equipment includes the remains of former washing plants, camp buildings, and a water ditch from Willow Creek to the property.

The alluvium consists largely of angular rock fragments and sand, with a few large boulders, some weighing up to 5 tons. The depth ranges from 20 to 100 feet.

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Bedrock is a smooth sedimentary formation The highest-grade material is found on bedrock and on a false stratum a few feet above it. The gold, both fine and coarse, is associated with some black sand. Its fineness ranges from 875 to 890. Nuggets valued up to several hundred dollars have been found. Limonite and quartz are attached to the gold, indicating that it is local in origin and has not traveled far from its source. Gold is probably derived from copper-gold deposits a short distance northeast of the placers.

Turquoise deposits

Turquoise of excellent quality occurs in the Copper Basin area on ground owned by the Copper Canyon Mining Co. Although it was discovered by Duke Goff of Battle Mountain in 1918 while prospecting for copper, no work was done until 1937, when the American Gem Co. of Los Angeles obtained a lease from the Copper Canyon Mining Co. and began production. In 1937, the company produced 424 pounds of turquoise valued at $20 per pound for royalty purposes. In April 1938, the American Gem Co. employed a crew of 6 men. Equipment includes a Sullivan portable compressor, jack hammer, and other mining tools.

The turquoise occurs near the surface in a network of veinlets within a shale formation. The width of the veinlets ranges from 1/16 to 1/2 inch, but those of best quality range from 1/8 to 1/4 inch. The turquoise is hand-cobbed and sent to Los Angeles, where it is sorted, polished, cut, and set into rings, bracelets, brooches, belt buckles, and similar articles.

Other Mines

In addition to the foregoing properties, a large number of others were active in former years, and some have had large productions.

J. A. Langwith, of Winnemucca, Nev., owns a group of 22 claims in the vicinity of Galena, which includes the White and Shiloh, Trinity, and Avalanche mines, prominent silver producers in the early days. The mines have been developed extensively by a number of shallow shafts and several adits. No work has been done at depth since about 1905, when the mines were worked by a French company. The White and Shiloh, Battle Mountain, Avalanche, and Trinity veins are described by Hill[7].

The chlorination tailings from former milling operations have been scattered by wind and rains, but about 3,000 tons is still available. In 1937 Verne Johnson and Walter G. Moore of Galena shipped 5 carloads of selected tailings that averaged $18 per ton, chiefly in silver with a little gold.

The Little Giant mine, also a noted producer of silver ore in the early days, has been rehabilitated in recent years by the Little Giant Gold & Silver Mining Co. According to Hill,[8] the vein strikes N. 30° to 60° W. and dips southwesterly at medium angles. It has been developed by eight adits and several shafts. At the surface the vein has been stoped for a length of 1,700 feet.

7/ Hill, James M., Some Mining Districts in Northeastern California and Northwestern Nevada: Geol. Survey Bull. 594, 1915, pp. 85-87.
8/ Hill, James M., work cited, pp. 81-82.

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The San Miguel Nevada Mines, Ltd., controlled by Detroit interests, owns the Iron Canyon group of five patented claims in Iron Canyon. The property has been developed by several adits and an inclined shaft about 80 feet deep. Gold is the principal economic mineral; it occurs in irregular deposits in silicified sediments. The property is regarded favorably by experienced leasers in the district, but the company has been averse to leasing any part of the mine.

The Modoc group of six unpatented claims 5 miles west of Copper Canyon is owned by Charles L. Caldwell and R. H. Raring, of Battle Mountain, Nev. A small makeshift amalgamation mill was erected on the property in 1928, but the tailings pile gives evidence that not more than 200 tons of ore were treated. Free gold occurs in narrow seams in diorite.

The Big Four Annex group of one claim and several fractions, unpatented, is about 2 miles southwest of Galena. The owner, Donald A. McDonald of Galena, has shipped several carloads of ore from the property in recent years. Development comprises an adit 100 feet long and a winze 30 feet deep. Irregular, narrow, silver- and gold-bearing quartz veins are found in shale and quartzite.

The Antimony King group of three patented claims, owned by Guy E. Mitchell of Battle Mountain, Nev., is on a narrow ridge between two forks of Cottonwood Canyon. The deposits were discovered in the seventies, and several hundred tons of high-grade antimony ore were shipped to Swansea, Wales. The antimony occurs chiefly as stibnite in a quartz vein in shale and quartzite. The strike of the vein is nearly north and south with a steep dip westerly, and it ranges from 2 to 6 feet in width.

BIG CREEK DISTRICT

The Big Creek district is in the vicinity of a small stream of the same name on the west slope of the Toiyabe Range about 10 miles south of Austin. It adjoins the Reese River district on the south and the Birch Creek district on the north. A number of antimony veins in this area originally were located for silver in 1863, and a short-lived boom ensued. Lander City, built in Reese River Valley at the mouth of Big Creek in 1863, had several hundred inhabitants and a telegraph line, but a short time after, the mines not proving successful, the town was abandoned.

The Bray antimony mine was relocated in 1891 by Joseph Bray, and intermittent shipments of hand-cobbed ore containing 50 percent antimony were made. Operations were suspended in 1898. Stimulated by high prices, the antimony mines were reopened during the World War, and some hand-cobbed ore was shipped to the antimony smelter at Matawan, N. J., owned by the Magnolia Metal Co. of New York. Virtually no antimony ore has been produced since the World War.

The Bray mine, consisting of one patented claim, is owned by Mrs. Mary Bray. The Austin Silver Mining Co. owns one patented antimony claim and a patented mill site in Dry Canyon. A number of other unpatented claims are owned by various individuals.

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According to Hill9/ at the Pine mine the antimony is present in a silicified fault breccia cemented by quartz intergrown with stibnite. The ledge strikes N. 55° W. and dips 50° SW., being about 40 feet wide and traceable along the strike for nearly 400 feet.

At the Bray mine the stibnite occurs in a network of quartz stringers and as tabular irregular lenses of quartz and stibnite with a little tetrahedrite.

At present prices, the mining of antimony ore is not profitable in Nevada unless the ore is associated with some other valuable metal. At 20 cents per pound, the Big Creek deposits could be expected to produce some antimony.

BIRCH CREEK DISTRICT

The Birch Creek district, also known as Smoky Valley, is in the vicinity of Geneva Peak (altitude 10,994 feet) on the east flank of the Toiyabe Range, 12 miles south of Austin. It adjoins the Reese River district on the south, Big Creek on the east, and Kingston on the north. In 1863 silver-lead deposits were discovered in this area, and the Smoky Valley district was organized. A 20-stamp mill was erected at the mouth of Birch Creek to treat ore from the Big Smoky mine, but it operated only a short time. Although a number of properties were worked in the early days, production was small.

In 1916 John Cahill discovered high-grade gold ore, and the Nevada Birch Creek Mining Co. was organized in 1919 to carry on development work. Some gold ore was shipped from the property, but in recent years it has been inactive

Nevada Birch Creek Mining Co.

The Nevada Birch Creek Mining Co., G. L. Belanger, secretary and treasurer owns a group of eight unpatented claims.

Development includes two adits, the longest 475 feet in length and cutting the vein at a depth of 150 feet from the surface. Underground workings total about 2,000 feet. There is no mining or milling equipment on the property.

The prevailing rocks in the vicinity of the mine are andesite, rhyolite, and granodiorite. Gold ore occurs in bunches in a steeply dipping vein that strikes nearly north and south. Gold is in a free state in a gangue of quartz, fluorite, sericite, and crushed country rock stained with iron oxides.

At the mouth of the canyon below the mine several shafts have been sunk in the alluvium for placer gold. One shaft was sunk to a depth of 150 feet without finding bedrock. The material on the dump consists largely of granodiorite fragments. The results of this work were discouraging.

9/ Hill, James M., Some Mining Districts in Northeastern California and Northwestern Nevada: Geol. Survey Bull. 594, pp. 121-123.

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BUFFALO VALLEY DISTRICT

The Buffalo Valley district, also known as the Mill Canyon, is on the western slope of the Battle Mountain Range in T. 32 N., R. 42 W., M. D.B. & M., 17 miles in a southerly direction from Valmy, a station on the main line of the Southern Pacific Railroad and the Victory highway. From Valmy the property is accessible by automobile over a fair desert road. Buffalo Valley, from which the district derives its name, lies south of the Battle Mountain Range.

First prospecting in this area was done in the sixties, but no important discoveries were made at that time and activity ceased until 1912, when Clyde Ganser and others located a number of claims on and adjacent to a small hill where extensive croppings were found to contain gold. The principal groups of claims were purchased by the Buffalo Valley Mines Co., organized in 1916. This company, with only limited funds available, has prospected its holdings intermittently, efforts being directed toward blocking out a large tonnage of milling-grade ore. In 1936 the company obtained a Class B prospecting loan of $20,000 from the Reconstruction Finance Corporation, which was spent on further exploration of the known ore bodies. In May 1938 three men were employed at the property in mining shipping ore by hand methods.

Although there are a number of mines on the eastern slope of the Battle Mountain Range, the Buffalo Valley Mines Co. is the only promising property so far discovered on the western slope; it is isolated from the other mines of the district.

The production of the Buffalo Valley Mines Co., according to John T. Reid of Lovelock, has been 268 tons of ore averaging 0.695 ounces in gold and 1.88 ounces in silver, which was shipped to the Mammoth Smelter at Keswick, Calif., in 1924; and 792 tons averaging $8.96 per ton (gold figured at $20.67 per ounce), which was treated locally in a small cyanide leaching plant over a period of several years. In addition, several carloads of ore were shipped to the Salt Lake smelter early in 1938.

Buffalo Valley Mines Co.

The Buffalo Valley Mines Co. is incorporated under the laws of Arizona with a capitalization of 1,500,000 shares, par value $1, of which 750,000 shares have been issued. John T. Reid of Lovelock, Nev., is president and principal owner. The property comprises 28 unpatented claims and fractions and the water rights of Mill Canyon near the mine.

Equipment consists of a 15 horsepower gasoline hoist, a partly dismantled cyanide leaching plant (capacity 10 tons per day), assay office and equipment, blacksmith shop, tools for hand mining, and camp accommodations for a crew of 10 men.

Development includes 5 adits, 36 prospecting shafts ranging from 5 to 40 feet deep and totaling about 800 feet, and other workings totaling approximately 2,800 feet. The main adit is 600 feet long. The deepest working is 240 feet below the surface.

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The formation comprises a series of limestones, cherts, shales, and slate beds having a general strike of north and south and dipping 35° to 45° westward. The gold deposits occur along the bedding planes and in the fractured zones of limestones in proximity to an aplite dike that cuts the sedimentary strata at acute angles both as to strike and dip. Ore consists of silicified ferruginous material carrying gold with minor amounts of silver. In places, oxidized copper minerals are present. Gold values increase with the copper content of the ore.

According to John T. Reid, the Hill and Estes discovery shaft, sunk to a depth of 90 feet, penetrated ore 30 feet from the surface. The first 15 feet averaged $13.60 in gold and the second 15 feet $5.50, a general average of $9.55 for 30 feet with gold at $20.67 per ounce. This shaft was sunk 60 feet farther to connect with the Fayant adit, which is 365 feet long. Fifteen feet from the portal of the Fayant adit a heavy gouge was cut where mineralization begins, and from this point the following samples taken by Reid and assayed by A. F. Bardwell of Salt Lake City, Utah, gave the following results:

Sample	Length, feet	Assay value per ton	Value of product
1	20	$2.35	$47.00
2	20	1.60	32.00
3	20	2.68	53.60
4	7	6.05	42.35
5	8	1.95	15.60
6	23	23.90	549.70
Total	98		740.25
Average uncut value per ton			7.55

The adit in which the foregoing samples were taken cuts the ore body at an acute angle to its strike. The true width of the ore body is about 25 feet.

Another adit driven to cut the Hill and Estes vein at greater depth intersects the walls of the vein at points respectively 260 and 300 feet from the portal. The average grade of the vein material over this 40-foot width is reported to be $3.10 per ton with gold at $20.67 per ounce. The true width of the vein is about 25 feet. From this adit drifts were extended on the Hill and Estes vein, and in one place 1,060 tons of ore was extracted, of which 268 tons was shipped to the Mammoth smelter at Keswick, Calif., and 792 tons was milled locally. The average analysis of the smelter shipments was as follows:

	Ounces
Gold.....	.695
Silver.....	1.88
	Percent
Silica.....	85.4
Iron.....	4.1
Alumina.....	1.5
Lime.....	1.5

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In addition to the Hill and Estes vein there is another vein in the lower adit near the portal. This vein is composed of crushed material occupying a position between a limestone footwall and overlying surface detritus. Over a width of 9 feet the crushed material averages $2.50 in gold at the old price of $20.67 per ounce.

Tests made in the small cyanide leaching plant erected about 1925 showed that a recovery of 85 percent of the gold and silver can be obtained by crushing to minus 10-mesh and a 4-day leaching cycle. Reagent consumption was 1/4-pound sodium cyanide and 2 pounds lime per ton of ore.

BULLION DISTRICT

The Bullion district, also known as the Lander district, is on the east slope of the Shoshone Range about 23 miles southwest of Beowawe, the nearest shipping point. It adjoins the Hilltop district on the southeast. The first locations were made here sometime in the seventies, when the town of Lander (now abandoned) was established. In the early days a number of small silver properties were operated, including the Silver Side, Grey Eagle, and Lovie mines. The latter was the principal producer and was equipped with a five-stamp pan amalgamation mill. In the spring of 1905 Charles Montgomery discovered gold ore about 2 miles southeast of Lander, and the camp of Tenabo was established more conveniently situated to the mines. A rush to Tenabo took place in 1907, and although it attained a population of nearly 1,000, the following year all but a few had left.

The placer deposits in the vicinity of Tenabo were discovered by A. J. Raleigh in 1916. No accurate statistics on the metal production in the district prior to 1902 are available. The Lovie mine is credited with a production of at least $200,000 in silver, and a number of other properties are known to have produced smaller amounts. From 1902 to 1936 the metal production (table 4) was $947,612, chiefly in silver and gold with some copper and lead.

Goldacres Mine

The Goldacres mine, owned by a Denver group, comprises 50 unpatented claims on the east side of the Shoshone Range about 5 miles south of Tenabo and 30 miles south of Beowawe, the nearest shipping point. Although the property was prospected many years ago, there was no production until 1936, when the present company began operations under the management of E. J. Bumstead. The mine is unique, in that it has been operated profitably from the beginning on ore carrying a little over $4 per ton in gold. In April 1938, 11 men were employed at the mine, and daily production was about 25 tons of ore.

The mine is developed by an adit 400 feet long and subsidiary workings totaling about 2,500 feet. Equipment includes a compressor, blacksmith shop, machine drills, assay office, cyanide leaching plant, and camp accommodations for a crew of 15 men.

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TABLE 4. - Gold, silver, copper, and lead production from Bullion district, Lander County, Nevada, 1902-1936, in terms of recovered metal

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Placer					Lode			
	No. of mines	Gold		Silver		Total value	No. of mines	Ore	Gold	
		Fine ounces	Value	Fine ounces	Value			Short tons	Fine ounces	Value
1902-04	-	-	-	-	-	-	-	-	-	-
1905	-	-	-	-	-	-	1	35	87.66	$1,812
1906	-	-	-	-	-	-	4	510	483.56	9,996
1907	-	-	-	-	-	-	6	2,425	4,113.19	85,027
1908	-	-	-	-	-	-	8	227	151.07	3,123
1909	-	-	-	-	-	-	2	53	32.70	676
1910-11	-	-	-	-	-	-	-	-	-	-
1912	-	-	-	-	-	-	5	214	42.63	881
1913	-	-	-	-	-	-	1	46	1.95	40
1914	-	-	-	-	-	-	2	498	15.55	321
1915	-	-	-	-	-	-	4	128	14.18	293
1916	-	-	-	-	-	-	4	609	175.17	3,621
1917	-	-	-	-	-	-	2	587	15.97	330
1918	-	-	-	-	-	-	2	1,222	514.50	10,536
1919	-	-	-	-	-	-	5	183	18.20	376
1920	-	-	-	-	-	-	5	157	13.00	269
1921	-	-	-	-	-	-	4	199	25.43	526
1922	-	-	-	-	-	-	1	29	.08	2
1923	-	-	-	-	-	-	3	49	69.68	1,440
1924	-	-	-	-	-	-	1	10	.02	-
1925	-	-	-	-	-	-	4	672	120.99	2,501
1926	-	-	-	-	-	-	4	2,070	1,444.79	29,866
1927	-	-	-	-	-	-	6	640	534.70	11,053
1928	-	-	-	-	-	-	4	105	344.30	7,117
1929	-	-	-	-	-	-	3	72	39.58	818
1930	-	-	-	-	-	-	1	47	157.86	3,263
1931	2	13.54	$280	2	$1	$281	1	22	110.54	2,285
1932	2	55.65	1,150	6	2	1,152	4	26	119.44	2,469
1933	2	54.39	1,390	8	3	1,393	2	223	223.77	5,720
1934	4	208.73	7,295	21	13	7,308	7	963	248.81	8,696
1935	9	386.07	13,512	41	29	13,541	9	5,304	697.42	24,410
1936	12	392.72	13,745	41	32	13,777	9	6,411	2,881.75	100,861
Total	-	1,111.10	37,372	119	80	37,452	-	23,736	12,698.49	318,428

See footnote on page 41

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TABLE 4. - Gold, silver, copper, and lead production from Bullion district, Lander County, Nevada, 1902-1936, in terms of recovered metal (Continued)

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode								Total value (lode and placer)
	Silver		Copper		Lead		Total value	Average recoverable value of ore per ton[1]	
	Fine ounces	Value	Pounds	Value	Pounds	Value			
1902-04	-	-	-	-	-	-	-	-	-
1905	-	-	-	-	-	-	$1,812	$51.77	$1,812
1906	31,930	$21,393	295	$57	76,506	$4,360	35,806	70.21	35,806
1907	107,102	70,687	325,604	65,121	679,102	35,992	256,827	105.91	256,827
1908	6,127	3,247	3,159	417	57,714	2,424	9,211	40.58	9,211
1909	1,456	757	2,023	263	15,535	668	2,364	44.60	2,364
1910-11	-	-	-	-	-	-	-	-	-
1912	17,574	10,808	7,819	1,290	85,041	3,827	16,806	78.53	16,806
1913	12,521	7,563	922	- 143	-	-	7,746	168.39	7,746
1914	117,879	65,187	4,451	592	258	10	66,110	132.75	66,110
1915	31,876	16,161	-	-	-	-	16,454	128.55	16,454
1916	68,776	45,255	712	175	5,131	354	49,405	81.12	49,405
1917	43,457	35,809	3,817	1,042	926	80	37,261	63.48	37,261
1918	58,786	58,786	203	50	-	-	69,472	56.85	69,472
1919	13,897	15,565	125	23	5,785	307	16,271	88.91	16,271
1920	13,493	14,707	326	60	2,351	188	15,224	96.97	15,224
1921	5,996	5,996	13,060	1,685	18,188	818	9,025	45.35	9,025
1922	2,572	2,572	239	33	18,176	1,000	3,607	124.38	3,607
1923	1,887	1,547	422	62	11,565	810	3,859	78.76	3,859
1924	804	539	186	24	7,536	603	1,166	116.60	1,166
1925	19,395	13,460	44,475	6,315	99,970	8,697	30,973	46.09	30,973
1926	5,986	3,735	27,796	3,892	15,300	1,224	38,717	18.70	33,717
1927	7,127	4,041	1,153	151	37,166	2,341	17,586	27.48	17,586
1928	1,225	717	-	-	8,024	465	8,299	79.04	8,299
1929	1,298	692	2,601	458	11,283	711	2,679	37.21	2,679
1930	18	7	-	-	-	-	3,270	69.57	3,270
1931	29	8	-	-	-	-	2,293	104.23	2,574
1932	42	12	-	-	715	21	2,502	96.23	3,654
1933	1,685	590	3,310	212	200	8	6,530	29.28	7,923
1934	9,067	5,862	44,357	3,549	5,002	185	18,292	18.99	25,600
1935	13,433	9,655	44,742	3,714	5,050	202	37,981	7.16	51,522
1936	17,709	13,716	70,994	6,531	32,698	1,504	122,612	19.13	136,389
Total	613,147	429,074	602,791	95,859	1,199,222	66,799	910,160	38.35	947,612

1/ Not to be confused with average assay value of ore.

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The gold occurs in a shear zone in iron-stained, silicified limestone intruded by porphyry. The principal ore body lies between a porphyry hanging wall and a blue limestone foot wall and strikes N. 40° W., with a flat dip to the southwest. At the surface the ore body is covered to a depth of from 5 to 10 feet with material averaging 0.02 in gold. It is impossible to distinguish between ore and waste except by assay, and gold is present in such a state that it is impossible to obtain a single color by panning. Up to April 1938, 225,000 tons of positive ore and about the same amount of probable ore averaging $2.85 per ton had been developed.

About 1,000 feet from the main ore body a large open-cut shows ore of the same character. Not enough prospecting has been done to determine whether or not the two ore bodies are connected.

The pilot cyanide-leaching plant at the mine has a maximum capacity of 30 tons per day and is characterized by its simplicity. The ore is hand-tramm from the mine and dumped into a coarse-ore bin. From the bin, the ore is crushed to 2-inch size by an Austin gyratory crusher, whence it passes into a second ore bin. The crushed ore, containing about 25 percent slimes, is transferred to the leaching tanks by hand-trammed cars. There are four steel leaching tanks, each 9 feet in height and 15 feet in diameter. The leaching cycle requires about 7 days, and the cost and consumption of reagents are as follows:

	Amount per ton of ore, pounds	Cost per ton of ore
Sodium cyanide..	1.27	$0.266
Lime	6.20	.155
Zinc shavings...	.88	.162
Total cost of reagents per ton		.583

Water for milling is pumped from a well 80 feet deep on the flat 3 miles east of the mine, and it is trucked uphill to the mine at cost of $1 per ton. The water consumption is 1/4 ton per ton of ore, and the cost is 25 cents per ton of ore. The tailings are discharged from the leaching tanks by gravity and are hand-shoveled into mine cars, which are trammed a short distance to waste piles. In addition to the leaching tanks, there are two pregnant-solution tanks (14 by 6 feet), two sump tanks (10 by 12 feet), and two stock-solution tanks (10 by 8 feet. Precipitation is effected with zinc shavings in zinc boxes consisting of four rows with five cells in each box. By crushing to 2-inch size, the extraction of the gold is between 87 and 90 percent. On one occasion the crusher broke down and the mine-run material up to 4 inches in size was treated, and the extraction was 80 percent.

Little Gem Mine

The Little Gem mine comprises one patented and three unpatented claims on the east slope of the Shoshone Range 21 miles south of Beowawe, Nev., the nearest shipping point. In recent years the property has been operated by George L. McCracken and associates, chiefly for shipping ore. In 1937 a 50-ton flotation mill was built on the west side of Crescent Valley 3 miles from the mine, but it was closed after operating a short time because of metallurgical difficulties.

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Development consists of a shaft 435 feet deep inclined about 35°, with levels at 30-, 130-, 200-, 300-, and 400-foot stations, measured on the incline. Total underground workings aggregate about 1,500 feet. Equipment includes a 10-horsepower Fairbanks-Morse geared hoist, a Sullivan Unitair portable compressor, blacksmith shop, and various mining tools. The mill is equipped with crusher, Eimco ball mill (4 by 5 feet), Simplex classifier, and 10 Booth-Thompson flotation cells.

The country rock is a fine-grained andesite. The ore occurs in a fault fissure vein 1 to 6 feet in width, averaging 4 feet, with a general east and west strike and a flat dip southward. The oxidized ore is composed of copper carbonates, silver chloride, and some free gold. The sulphide ore minerals, found at a depth of about 100 feet below the surface, are chalcopyrite, bornite, arsonopyrite, pyrite, galena, and sphalerite; a little gold is associated with the sulphides. The vein is composed largely of quartz and crushed country rock. Most of the production, amounting to several thousand tons, has been shipping ore taken from the oxidized zone. According to McCracken, an appreciable tonnage of sulphide ore is available, but it is too low grade to ship. A trial shipment made on June 16, 1934, to the American Smelting & Refining Co. had the following analysis:

	Ounces
Gold	0.10
Silver	9.2
	Percent
Copper	2.95
Insoluble	56.2
Sulphur	12.1
Arsenic	4.6
Iron	13.9
Lime	.9

Mill Gulch Placer Mining Co.

The Mill Gulch Placer Mining Co., Keith Scott of Los Angeles, Calif., manager and principal owner, controls a large acreage of placer ground at Tenabo, 24 miles south of Beowawe, Nev. The company purchased the Mill Gulch group of placer claims from A. E. Raleigh in 1936, and subsequently a large number of claims in the Tenabo area were acquired by location. A floating washing plant and a dragline were installed, and placer operations started on March 15, 1937. Since then operations have been successfully carried on continuously on a 24-hour day basis. In April 1938 the company employed a crew of about 16 men. Prior to the acquisition of the Mill Gulch placer, the only activity was some small-scale mining with rockers and dry washers by A. E. Raleigh and lessees.

Equipment includes a washing plant on a floating barge 30 feet wide and 40 feet long, a Link-Belt Speedomatic dragline unit having a boom 60 feet long and a 1-3/4-cubic-yard-capacity, heavy-duty Page bucket and R. D. 7

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caterpillar tractor with a Le Tourneau bulldozer attachment, drilling and sampling equipment, pumping plant, and camp accommodations for a crew of 20 men. The barge is built of 3-inch plank on the sides and bottom, with 4-inch plank at the ends. The boat is trussbraced, with two cross bracings and two that run lengthwise. After the barge was built, heavier equipment was installed, and to provide for extra carrying capacity, three auxiliary steel pontoons were added, one on each side and the third at the stern. The barge has 40 inches draft, with 6 inches freeboard.

No yardage measurements are made, but it is estimated that the plant has a capacity of about 1,500 cubic yards per day. The trommel is 24 feet in length and 54 inches in diameter, and divided into two sections; the upper portion is of unpunched steel plate with three spiral flights for disintegrating the gravel, and the lower half is a steel screen with 3/8-inch holes. It is chain-driven, and the slope is 1-1/2 inches per foot.

The cross-riffle sluices are 30 inches wide and 12 feet long, and there are 6 cross sluices on each side of the screen. These discharge into side sluices, one on each side of the barge. The side sluices terminate in steel flumes that project about 6 feet beyond the rear of the barge. The total riffle area is 460 square feet. The riffles are of the conventional type, 1-1/4 inches square and spaced on 3-inch centers, and lined on the top with strap iron. They are built in sections so that they are readily removable when clean-ups are made. Water for washing and sluicing is pumped from the pond by a 6-inch Fairbanks-Morse centrifugal sewage and trash pump. The trommel oversize is discharged on a stacker belt 24 inches wide and 70 feet long. Power for the washing plant is furnished by a D-17000, caterpillar, 160-horsepower, V-type, 8-cylinder, Diesel engine mounted on the barge. For night work the barge is equipped with 5- k.v-a. Kohler lighting plant. The barge is also equipped with Bodinson electric winch for holding the boat in position. Clean-ups are made daily; the concentrate is washed in a Denver pan.

Water is obtained from a well in the valley to the east and is pumped to the pond by a multistage turbine pump connected to a D-13000, caterpillar, Diesel engine. The pipe line is 15,000 feet in length and made of 12-gage iron pipe 8 inches in diameter. The pumping lift averages about 500 feet.

The caterpillar tractor with bulldozer attachment is used for leveling the ground in advance of digging operations, for road building, and for heavy hauling.

A Keystone drill and a G. B. portable placer machine are used for sampling the ground ahead of mining.

Mill Gulch is a shallow ravine several miles long and 200 to 300 feet in width. The alluvium is composed largely of sand and medium-size boulders. The depth to bedrock ranges from 10 to 45 feet, averaging about 30 feet. Most of the gold is found near bedrock. The gold is both fine and coarse, with a fineness of about 920. A little scheelite is associated with the gold.

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Triplett Gulch Placer

The Triplett Gulch placer is at Tenabo about 1/2 mile south of Mill Gulch. The main part of the Gulch is covered by 9 unpatented claims owned by Mrs. G. W. Triplett and E. O. Swackhammer of Battle Mountain; for the past three years this ground has been worked under lease by Herman Rieck and associates. In April 1938 about 40 individuals were working the ground under sublease agreements with various types of dry-washing equipment ranging in capacity from a few yards to 50 cubic yards per 8-hour day.

The placer material is chiefly sand and soil containing a small proportion of angular rock fragments, none exceeding 5 inches in diameter. The depth of the alluvium ranges from 1 to 12 feet, averaging about 6 feet. The average value of the placer material treated by dry washing is about $2 per cubic yard.

The largest operation at the time of the writer's visit was that of Reick and partners, who used power equipment. In working the placer, the ground is first broken to a depth of about 1 foot with a scarifier drawn by a 15-horsepower caterpillar tractor. It is then worked over with a spring-tooth harrow; the loosely cemented lumps of sand are broken by a flat-bottomed stone boat made of 2-inch plank weighted with stone and dragged behind the harrow. After the material is harrowed, it is allowed to dry thoroughly and is then hauled by tractor and scraper to a grizzly ramp near the dry-washing plant. The grizzly is made of 20-pound rails spaced with 3-inch openings. The undersize falls onto a Jeffrey portable conveyer, which elevates it to an inclined, 1/2-inch-mesh, woven-wire screen above a hopper. The undersize drops into the hopper, which discharges into a battery of two power-driven dry-washing machines. The screen oversize falls to the ground in front of the dry washer and is hauled away with the dry-wash tailing by tractor and scraper.

The dry-washing machines are the conventional bellows-type air jigs commonly used throughout the arid regions of the southwest. They are belt-driven by a 2-horsepower Fairbanks-Morse gasoline engine mounted 50 feet in the rear of the dry-washing equipment to avoid the dust. With the foregoing equipment, three men can handle about 50 cubic yards per day. Operations are slowed, however, by weather conditions; a light rain stops the work until the ground dries.

Mud Springs Placer Deposits

Placer-gold deposits occur in the vicinity of Mud Springs on the east slope of the Shoshone Range 8 miles northwest of Tenabo. The first placer discovery was made here in 1907 by Gus Fowler of Beowawe. The deposits have been worked intermittently by hand methods, and production has been only about $2,000.

Placer gold has been found in Mud Springs, Rose Bud, and Tub Springs Gulches, but most of the activity has been confined to Mud Springs Gulch, which is about 4 miles in length and averages 300 feet in width. About 30 shafts 60 to 90 feet deep have been sunk to and into bedrock along the course of

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the gulch. The upper portion of the alluvium consists of sand and soil and the lower part of a heterogenous mass of small and large boulders, in places cemented. Most of the gold is concentrated near bedrock. At the head of the gulch the gold is coarse and angular, but it becomes finer in proportion to the distance it has traveled down stream. The gold was probably derived from the erosion of quartz veins in the vicinity of Granite Mountain.

Other Mines

The Gold Quartz mine, owned by Thomas S. Wilson and associates, comprises a group of five unpatented claims at Tenabo. The mine has been operated with some success in recent years by the Cuba Consolidated Mining Co.

The mine is developed by two shafts, the deepest about 300 feet, and other workings totaling several thousand feet. Equipment includes a Fairbanks-Morse 6-horsepower geared hoist, a compressor (7-3/4 by 12 inches), blacksmith shop, a 20-ton flotation mill, and camp buildings.

The prevailing formation is quartzite cut by a quartz-bearing porphyry intrusive and by basalt, according to Emmons[10]/ Free gold occurs in a shattered, altered quartzite cut by stringers of iron oxide. The ore is oxidized to a depth of 75 feet. In the sulphide zone arsenopyrite and pyrite are the principal sulphides.

A. E. Raleigh of Tenabo owns 19 claims in three groups in the Tenabo area the Gylding group of seven claims, the Blue Rock group of five claims, and the Gold Pen group of seven claims, all unpatented. Lessees have made intermittent shipments from the various groups. There is very little equipment on the property. Development comprises a number of shafts, the deepest of which is about 300 feet. Last production was made from the Gold Pen mine several years ago, when 20 cars of ore averaging $42 per ton (chiefly in gold) were shipped by lessees.

The Grey Eagle mine, about 4 miles southwest of the Hilltop mine, has been rehabilitated by Detroit interests in recent years. This mine has been worked intermittently since the seventies and is reported to have produced several hundred thousand dollars in silver, gold, and lead. The deposit is a quartz fissure vein in granodiorite, striking N. 70° E. and dips 70° N. The ore minerals include sphalerite, galena, pyrite, and gray copper, which have been altered near the surface to oxides, carbonate, and chloride[11]/

The Lovie, Silver Prize, and Silver Side mines in the vicinity of the old camp of Lander, operated in the early days for silver ores, have been inactive in recent years.

10/Emmons, William H., A Reconnaissance of Some Mining Camps in Elko, Lander, and Eureka Counties, Nev.: Geol. Survey Bull. 408, 1910, pp. 117-118.
11/Emmons, William H., Work cited, p. 120.

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HILLTOP DISTRICT

The Hilltop district, also known as the Kimberly, is on the northwest slope of Shoshone Peak (altitude 9,760 feet) in the Shoshone Range 18 miles southeast of Battle Mountain. It adjoins the Bullion district on the northwest and the Lewis district on the southeast. This area was prospected in the early days of Austin; but no important discoveries were made until 1907, when Matt Scow, associated with Harry Anderson and Nels Duborg, discovered wire gold in the vicinity of some old workings. Other discoveries followed, and the following year there was a lively boom. Several companies were organized, and the ground was divided into lease blocks. A number of shipments of ore were made; one lease on the Independence claim owned by the Philadelphia Western Mining Co. is said to have produced $15,000 in shipping ore. About 1910 the Hilltop Milling & Reduction Co. erected a 10-stamp amalgamation-concentration mill, which was changed to an all-slime cyanidation plant in 1914. This company operated successfully for a number of years. In 1913 the Kimberly Consolidated Mining Co. took over the properties of the Philadelphia Western Mining Co. and was the principal producer for a number of years; its holdings were acquired eventually by the Hilltop Nevada Mining Co. This latter company erected a 100-ton flotation mill and power plant in 1922 and 1923, but it operated only a few months. In 1934 the Hilltop holdings were acquired by the Stone Cabin Consolidated Mines Co., and the flotation mill was dismantled and moved to a property near Dayton, Nev. In recent years most of the mining in the district has been done by lessees. In addition to the Hilltop properties, the Blue Dick, Kattenborn, and Red Top mines have been important producers. The last three mines are in the older portion of the Hilltop district.

The principal production in the district was made between 1912 and 1921. The total production from 1902 to 1936 (shown in table 5) was $701,855, chiefly gold and silver with small amounts of copper and lead.

Stone Cabin Consolidated Mines, Inc.

In the Hilltop district, the Stone Cabin Consolidated Mines Co. owns 1 patented railroad section, 16 patented claims, and the Golden Rule group of 7 unpatented claims. In recent years the only production has been from sporadic leasing operations. In 1937, Terry McGovern shipped 10 cars of ore averaging about 0.5 ounce in gold.

The property is developed by the main transportation adit, 1,800 feet in length, the Washington shaft, 365 feet in depth, the Burns and Independence adits, and other underground workings totaling about 7 miles. Equipment includes a 300-horsepower, Fairbanks-Morse, 6-cylinder, Diesel engine, a Chicago-Pneumatic compressor (9 x 14 inches), and a number of camp buildings.

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TABLE 5. - Gold, silver, copper, and lead production from Hilltop District, Lander County, Nevada, 1902-1936, in terms of recovered metal

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Placer						Lode			
	No. of mines	Gold		Silver		Total value	No. of mines	Ore	Gold	
		Fine ounces	Value	Fine ounces	Value			Short tons	Fine ounces	Value
1902-08	-	-	-	-	-	-	-	-	-	-
1909	-	-	-	-	-	-	2	53	613.25	$12,677
1910	-	-	-	-	-	-	3	52	210.57	4,353
1911	1	75.00	$1,550	20	$11	$1,561	2	180	218.08	4,508
1912	-	-	-	-	-	-	5	4,083	2,563.59	52,994
1913	-	-	-	-	-	-	3	10,065	2,894.94	59,844
1914	-	-	-	-	-	-	2	2,279	709.15	14,659
1915	2	8.20	170	2	1	171	2	1,170	712.63	14,731
1916	-	-	-	-	-	-	5	3,814	1,625.39	33,600
1917	-	-	-	-	-	-	7	3,151	1,045.82	21,619
1918	-	-	-	-	-	-	4	2,472	985.67	20,376
1919	-	-	-	-	-	-	5	938	1,077.70	22,278
1920	-	-	-	-	-	-	3	248	119.09	2,462
1921	-	-	-	-	-	-	3	292	800.12	16,540
1922	-	-	-	-	-	-	-	-	-	-
1923	-	-	-	-	-	-	2	149	143.00	2,956
1924	-	-	-	-	-	-	1	1	.04	1
1925	-	-	-	-	-	-	4	122	32.33	668
1926	-	-	-	-	-	-	3	70	44.65	923
1927	-	-	-	-	-	-	-	-	-	-
1928	-	-	-	-	-	-	1	52	17.81	368
1929	-	-	-	-	-	-	-	-	-	-
1930	-	-	-	-	-	-	2	300	252.00	5,209
1931	-	-	-	-	-	-	2	91	204.52	4,228
1932	-	-	-	-	-	-	2	115	124.86	2,581
1933	1	22.44	574	3	1	575	-	-	-	-
1934	1	4.28	150	1	1	151	3	533	668.07	23,349
1935	-	-	-	-	-	-	5	706	343.80	12,033
1936	1	8.75	306	2	1	307	4	1,622	515.90	18,057
Total	-	118.67	2,750	28	15	2,765	-	32,558	15,922.99	351,014

See footnote on page 49

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TABLE 5. - Gold, silver, copper, and lead production from Hilltop District, Lander County, Nevada, 1902-1936, in terms of recovered metal (Continued)

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode								Total value (lode and placer)
	Silver		Copper		Lead		Total value	Average recoverable value of ore per ton 1/	
	Fine ounces	Value	Pounds	Value	Pounds	Value			
1902-08	-	-	-	-	-	-	-	-	-
1909	627	$326	-	-	3,395	$146	$13,149	$248.09	$13,149
1910	230	124	28	$4	188	8	4,489	86.33	4,489
1911	297	157	-	-	4,046	92	4,757	26.43	6,318
1912	2,832	1,742	5,174	854	2,046	92	55,682	13.64	55,682
1913	7,849	4,741	88	13	972	43	64,641	6.42	64,641
1914	29,989	16,584	2,793	372	37,638	1,468	33,083	14.52	33,083
1915	25,591	12,375	4,101	718	32,558	1,530	29,954	25.60	30,125
1916	50,136	32,990	6,215	1,529	68,729	4,742	72,861	19.10	72,861
1917	23,783	19,597	36,875	10,067	47,900	4,119	55,402	17.58	55,402
1918	26,639	26,639	257,479	63,597	1,234	88	110,700	44.78	110,700
1919	28,028	31,391	21,500	3,999	268,039	14,206	71,874	76.62	71,874
1920	13,113	14,293	923	170	13,199	1,056	17,981	72.50	17,981
1921	5,279	5,279	14,312	1,846	2,123	96	23,761	81.37	23,761
1922	-	-	-	-	-	-	-	-	-
1923	2,968	2,434	5,553	816	569	40	6,246	41.92	6,246
1924	1,650	1,105	298	39	489	39	1,184	1,184.00	1,184
1925	16,586	11,511	908	129	4,351	379	12,687	103.99	12,687
1926	4,203	2,623	738	103	4,049	324	3,973	56.76	3,973
1927	-	-	-	-	-	-	-	-	-
1928	1,202	703	567	81	-	-	1,152	22.15	1,152
1929	-	-	-	-	-	-	-	-	-
1930	692	266	4,017	522	-	-	5,997	19.99	5,997
1931	603	175	3,314	302	-	-	4,705	51.70	4,705
1932	383	108	1,900	120	-	-	2,809	24.43	2,809
1933	-	-	-	-	-	-	-	-	575
1934	3,286	2,124	4,513	361	-	-	25,834	48.47	25,985
1935	23,246	16,708	-	-	-	-	28,741	40.71	28,741
1936	36,734	28,450	8,886	818	2,233	103	47,428	29.24	47,735
Total	305,946	233,045	380,182	86,460	493,758	28,571	699,090	21.47	701,855

1/ Not to be confused with average assay value of ore.

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The formation is chiefly quartzite with some interbedded siliceous shales and conglomerates. The sediments are irregular in strike and dip and are faulted and intruded by tongues of highly altered granodiorite porphyry. The ore is a brecciated quartzite cemented with quartz and carrying free gold and some silver. In the sulphide zone the associated ore minerals are pyrite, galena, and chalcopyrite. The ore bodies are irregular in width and strike but generally parallel the bedding of the sediments. In places the ore occurs in the quartzite with no apparent vein structure. The ore is said to contain a small amount of bismuth in places.

Red Top Mine

The Red Top mine, owned by the Pittsburg Red Top Mining Co., R. E. Rogers, president, of Los Angeles, Calif., comprises one patented section of land in the vicinity of the old camp of Maysville about 1 mile west of the Hilltop mine.

In the nineties, a Chilean mill and four amalgamating pans were placed in Krum Canyon below the mine to treat the ore, but no production statistics are available. In recent years the property has been under lease to Verdal C. Clark and R. G. Kirk, who have made sporadic shipments of high-grade ore to smelter.

Development consists of four adits, the longest of which is 1,400 feet, and subsidiary workings probably totaling about 5,000 feet. There is no equipment on the property other than tools for hand mining.

The prevailing formation is quartzite. The vein worked by lessees in recent years strikes N. 40° W., with a nearly vertical dip; it is rather small and is disturbed by numerous minor faults.

The ore occurrence is erratic, and numerous pannings are necessary to follow the material that is of high enough grade to constitute a shipping product. Free gold and some silver are associated with gray copper, arsenopyrite, sphalerite, galena, and other minerals in a gangue of quartz, calcite, a little fluorite, and brecciated quartzite. It is reported that the ore also contains gold tellurides and bismuth. The value of the ore is increased by screening through 1/2-mesh screen and shipping the undersize product. The smelter returns on a shipment of ore made on August 21, 1936, to the American Smelting & Refining Co. furnished the following data:

Metal quotations:	Gold	$34.9125 per ounce
	Silver	.77 per ounce
		Ounces per ton
Settlement assay:	Gold	3.62
	Silver	13.55
		Percent
	Copper	0.23
	Lead	.7
	Insoluble	81.84
	Zinc	.5
	Sulphur	2.3
	Iron	8.2
	Lime	.7

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	Pounds		
Wet weight, gross	45,020		
Weight, 530 sacks	534		
Moisture, 1.5 percent	44,486		
Moisture, 1.5 percent	668		
Dry weight	43,818 or 21.909 tons		
Smelter payment:	Gold, 100 percent at $32.31825 per ounce		$116.99
	Silver, 95 percent at $0.77 per ounce		9.91
	Gross value per ton		126.90
Treatment charge:	Base charge	$3.50	
	10 percent of excess over $20 value, max.	2.00	
	Treatment charge per ton	5.50	5.50
	Net value per ton		121.40
Deductions:	Freight at $9.50 per ton	$213.85	
	Hauling at $3.50 per ton	78.79	
		292.64	
	21.909 tons at $121.40		2,659.75
	Deductions		292.64
	Net proceeds		2,367.11

Blue Dick Group

The Blue Dick group of eight unpatented claims, owned by R. G. Kirk, Verdal C. Clark, and the J. E. Street estate, is in the western part of the Hilltop district about 20 miles wouteast of Battle Mountain. This property was discovered by George Dawson about 1900; it has been worked intermittently, principally by lessees for shipping ore. In 1917 and 1918 the property was operated by Earl Gilmore of the Gilmore Oil Co. of Los Angeles, who is reported to have mined 18 cars of shipping ore with a gross value of $20,000. In 1934 the property was leased to Harry C. Hauck and Andrew Kinneberg of Battle Mountain.

According to the shipping records, from November 1934 to October 1937 Hauck and Kinneberg shipped 2,492.42 tons of ore with a gross smelter value of $74,093, an average of $29.73 per ton. At the time of the writer's visit, two men were employed at the mine producing shipping ore.

Development consists of seven scattered adits, the longest about 250 feet, and subsidiary workings totaling about 2,000 feet. The deepest working is approximately 150 feet from the surface. Equipment includes a Worthington portable compressor (capacity, 210 cubic feet), a Sullivan tugger hoist, machine drills, blacksmith shop, and several camp buildings.

The principal vein, called the Blue Dick, is in quartzite; it strikes N. 45° W. and dips about 45° S.W. The width ranges from 1 to 5 feet The value is chiefly in silver with minor amounts of gold and a little copper in a gangue

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of quartz and brecciated quartzite. The smelter returns on a carload shipment made by Hauck and Kinneberg to the American Smelting & Refining Co. on October 9 1937, furnished the following data:

Metal quotations:	Gold	$34.9125 per ounce
	Silver	.77 per ounce
		Ounces per ton
Settlement assay:	Gold	0.0325
	Silver	31.1175
		Percent
	Copper	0.10
		Pounds
Wet weight		97,440
Moisture, 1.75 percent		1,706
Dry weight		95,734 or 47.867 tons

Treatment charge:	Base charge	$3.00	
	10 percent of excess over $20	.38	
	Labor increase 4/1/37	.59	
	Treatment charge per ton	3.97	
Smelter payment:	Gold, 100 percent at $31.81825 per ounce		$1.03
	Silver 95 percent at $0.77 per ounce		22.76
			23.79
	Treatment charge		3.97
	Net value per ton		19.82
	47.867 tons at $19.82		948.72
Deductions:	Freight advanced at $3.20 per ton	$155.90	
	Hauling at $3.50 per ton	170.52	
	Sampling	29.23	
	Assaying	6.00	
		361.65	
			361.65
	Net returns		587.07
	Royalty, 10 percent of net returns		58.71
	Net proceeds		528.36

Kattenhorn Mine

The Kattenhorn mine, owned by Mrs. Pearl Kattenhorn of Battle Mountain and Harry Burke of San Francisco, Calif., comprises a group of three unpatented claims near the Blue Dick property. It is reported to have produced about $200,000, mostly in the eighties, when it was equipped with two Huntington grinding units and four amalgamating pans. This mill closed in 1890. In recent years the property has been inactive.

The Kattenhorn vein is developed by six scattered adits and other lateral workings totaling several thousand feet. There is no equipment on the property.

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The Kattenhorn vein has about the same strike and dip as the Blue Dick and was mined chiefly for silver.

Placer Deposits

Placer gold was found in Krum Canyon by John Nelson in 1914. From 1914 to 1916 lessees produced about $2,000 in placer gold by drift mining. Total production has been about $3,000.

The principal placer property, known as the First Riffle group, is owned by Charles Grue of Battle Mountain and comprises 160 acres at the upper end of Krum Canyon and part of Hilltop Gulch. The upper end of Krum Canyon is a small basin about 1/2 mile wide and 1 mile long.

The Grue property has been prospected by four shafts ranging from 27 to 72 feet in depth and a bedrock drift about 500 feet in length. Prospecting has been handicapped considerably because of caving ground and water along bedrock. The alluvium near the surface is largely sand and mud and near bedrock is composed chiefly of rounded medium-sized boulders. Virtually all the gold is found directly above bedrock, which is composed chiefly of a graphitic lime shale and quartzite. Gold is fairly coarse and is about 870 fine. A small amount of black sand and considerable barite is associated with the gold.

Antimony Deposit

A deposit of antimony covered by two unpatented claims held by R. G. Kirk of Battle Mountain is in the western part of the Hilltop district. About 40 years ago 1,000 tons of antimony ore was treated locally for its silver in a mill originally erected to treat ore from the Red Top mine. This venture was unsuccessful. About 100 tons of sorted ore yielding 60 percent antimony was shipped from the property during the World War period. Since the World War the property has been inactive.

Development includes an adit 140 feet long and other surface workings comprising a total of several hundred feet. There is no equipment on the property.

The antimony occurs as stibnite in a contact vein between porphyry and gneiss.

Barite Deposits

A number of deposits of barite are in the north end of the Shoshone Range, and for convenience these deposits are mentioned under the Hilltop district. Barite was mined first in June 1930, when lessees shipped 1 carload from the deposit found by William Bretz and John Durkin between Krum and Slavin Canyons 14 miles southeast of Battle Mountain. This property was acquired by the Modesto Barium Products Co., and appreciable quantities of barium have been mined. It is reported that 4,500 tons of barite were shipped to the company plant at Modesto, Calif., during the summer of 1937.

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Another deposit owned by the Chemical & Pigment Co. of Oakland, Calif., is near the crest of the range about 4 miles southeast of Argenta Siding on the main line of the Southern Pacific Railroad. The last 3 miles of the road to the deposit is fairly steep, the ascent being about 1,400 feet in that distance. At the Argenta deposit the barite shows a bedded structure, the beds striking N. 15° E. and dipping about 25° easterly. Locally the beds are crumpled and broken. The material is broken by blasting and mined with power shovel into trucks, which haul it to the railroad siding. An open-cut shows that the barite is at least 60 feet thick. About 6,000 tons of barite were shipped during the summer of 1937. From the surface showings, this deposit is probably one of the largest in Nevada.

Barite also is found in the vicinity of Lewis Canyon; one deposit, covered by two claims owned by C. B. Lancaster and W. J. Caudle, is about 1 mile below the Dean camp. The barite occurs in a vein in a shale formation and is traceable on the surface for several thousand feet, in places showing a width up to 20 feet.

In the Star Grove mine, also in Lewis Canyon, barite is associated with silver-lead ores. In places there is as much as 10 feet of nearly pure barite.

No doubt with further prospecting other deposits of barite will be found in the north end of the Shoshone Range.

IZENHOOD DISTRICT

The Izenhood tin-bearing district is in the Sheep Creek Range in northern Lander County, 22 miles by automobile road north of Battle Mountain, a town on the Southern Pacific Railroad. Nuggets of wood-tin were discovered near the Izenhood ranch in 1914 by Ben Long while working for the Russell Cattle Co. Not recognizing the nuggets as tin, Long brought them to Battle Mountain, where they were tentatively identified by M. G. Thurston, a mining engineer, who had prospected tin veins in Mexico. This identification was confirmed by the University of California in the same year. After the presence of tin became known, a small boom ensued, and at least 150 lode and placer claims were located, principally by Battle Mountain residents. Several shallow shafts were sunk to prospect for lode and placer deposits; but after a short time interest in the district dwindled, and many of the claims reverted to the public domain. Early in 1938 the principal claims were taken over by Tasker L. Oddie of Reno, who made arrangements to prospect the placer ground. This work was under way in May 1938.

The principal group of claims in the tin-bearing area is owned by Mrs. R. R. Gamble, of Battle Mountain, and associates.

The nearest water supply consists of springs flowing several hundred gallons per minute at Warm Springs 1 mile distant; this water is used to irrigate the Izenhood ranch owned by the Russell Cattle Co. The district is not served by a public utility power company. There is no equipment on the property.

A report on the tin deposits was made by Adolph Knopf in 1916[12/].

12/ Knopf, Adolph, Tin Ore in Northern Lander County, Nev: Geol. Survey Bull. 640-G, 1916, pp. 125-138.

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Tin Veins

The tin veins are on the west slope of the Sheep Range and extend from a point 1/2 mile north of the Izenhood ranch to a point 2-1/2 miles north 40° east. The Sheep Range extends nearly north and south and attains a maximum elevation of about 6,000 feet above sea level or nearly 1,500 feet above the floor of the subjacent Humboldt Valley.

The veins have been prospected by two shafts each 50 feet deep, an adit 20 feet in length, and several trenches.

The prevailing rock formation is a series of rhyolite flows of considerable thickness. From a distance the rhyolite resembles granite, but on closer inspection it shows distinctly its rhyolitic character. According to King,[13] the rhyolite area is roughly triangular and extends 50 miles south by 40 miles east and west, constituting one of the largest areas of rhyolite found in the Fortieth Parallel Survey. In the western part of the tin-bearing belt the rhyolite is capped by basalt.

The tin-bearing belt extends east and west along the crest of the range for about 2 miles. Along this belt the rhyolite has been rifted in an east-west direction, and in the fracture planes there are small stringers of tin-bearing material ranging in width from a fraction of an inch up to 6 inches. Along these stringers occasional kidneys of tin ore occur. No regularity in the occurrence of such seams or kidneys has been established, and not enough prospecting has been done to determine the width of the tin belt.

At the eastern end a vertical shaft has been sunk to a depth of 50 feet on several stringers filled chiefly with iron oxides and quartz. The shaft is untimbered and filled with rubble to a depth of 20 feet. The rhyolite in the vicinity is banded and stained with iron oxides. A grab sample of the fine vein material on the dump near the shaft was panned by the writer and estimated to contain more than 1 percent tin. A grab sample of the coarse hard material from the same dump yielded only 0.06 percent tin by assay. These samples were taken merely to determine whether or not tin was present and are only indicative. A small hand-operated dry washer near the dump suggests that an attempt had been made to concentrate the fines by dry washing, but the results must have been discouraging.

At the western end of the belt an inclined shaft had been sunk to a depth of 45 feet on a stringer zone in the rhyolite. Here the stanniferous material is associated chiefly with chalcedony, opal, specular hematite, and quartz. The stringers strike nearly east and west and dip 55° N. About 100 feet north of this shaft several small stringers are exposed in an open-cut. A 10-pound sample from a pile of sorted ore containing about 8 ton was taken by the writer, and it assayed 7.56 percent metallic tin. This was a selected sample of the vein material and it would by no means be representative of the average value of the material excavated from the shaft.

Between the two shafts is a stretch of ground nearly 2 miles long and perhaps several hundred feet wide on which chalcedony and opalized rhyolite

13/ King, Clarence, Systematic Geology: Geol. Explor. of 40th Par., vol. 1, 1878, p. 624.

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float can be found. If trenching were done in the likely spots in this area, stanniferous stringers similar to those exposed in the shafts might be found. However, the finding of commercial deposits of tin ore depends largely on the occurrence of stringers rich and numerous enough to carry the intervening rhyolite, for it may be taken for granted that if there is any tin in the rhyolite itself it is finely disseminated and unlikely to be present in commercial quantities.

The tin occurs in the form of disseminated grains and as botryoidal nodules of "wood tin", so called by the mineralogists because of the resemblance of its fibrous concentric structure to that of exogenous wood. Associated minerals are hematite, both specular and ocherous varieties, chalcedony, opal, and quartz - a peculiar combination from a mineralogical viewpoint. Knopf also mentions tridymite and lussatite as common constituents. This association indicated that the mineralization resulted from the action of hot water. The minerals usually associated with stanniferous veins, such as topaz, tourmaline, fluorspar, wolframite, molybdenite, and others, are conspicuously absent.

Placer Tin

On the south side of the tin-bearing belt the mountain range is traversed by four steep ravines ranging from 1/2 to nearly 1 mile in length. In at least two of the ravines investigated by the writer the bedrock is exposed for nearly their entire lengths; weathering has occurred along the flow lines and joint planes of the rhyolite and formed a series of cracks and small potholes in which wood tin has been concentrated. Nuggets of wood tin ranging in size from a pea to a marble can be found in these concentrations. Due to the preciptitous nature of the ravines, the accumulation of detritus has been small; there has been no opportunity for the tin stone to concentrate in quantity, and the possibility of finding commercial deposits in the ravines themselves is remote. In former years attempts were made to placer-mine for tin in the ravines near the crest of the range, as evidenced by the remains of old rockers and sluice boxes. Water for such work was obtained from melting snow during the spring run-off. The amount of tin concentrate collected by this work could not be learned, but in all likelihood it was small.

The base of the range is skirted by an alluvial bench approximately 2 miles long and 1/4 to 1/2 mile in width. Here the alluvium consists of a heterogenous mass of sand, subangular pebbles, and boulders, the latter weighing up to 6 or 7 tons. Farther out, where the gradient is less, a flat is formed comprising an area of several thousand acres. Here the alluvium consists mainly of gravel covered with a mantle of soil about 20 feet thick, as shown by several shafts that have been sunk in this area. Two shafts, each 40 feet deep and a short distance east of Warm Springs did not reach bedrock. A large flow of water was found in sinking these shafts. According to report, this work was done by a company from British Burma. No information is available in regard to the amount of tin discovered. Not enough prospecting has been done in the placer area to determine whether tin occurs in commercial quantities. Since the mode of occurrence of the placer tin is analogous to that of placer gold in Nevada, it may be inferred that a uniform distribution

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of tin from surface to bedrock is unlikely and that the best values will be found in nests or pockets near bedrock. This erratic distribution of the mineral is due to climatic conditions whereby the tin concentrations are the result of cloudburst action.

KINGSTON DISTRICT

The Kingston district, also known as the Bunker Hill or Summit, is in Kingston Canyon on the west flank of the Toiyabe Range on the southeast side of Bunker Hill Peak, the highest summit in Lander County; the altitude is 11,735 feet. The entrance to Kingston Canyon is from Smoky Valley. Bunker Hill Peak divides the canyon at its head from Big Creek Canyon, which drains westward into the Reese River Valley, the two canyons forming a line that crosses the Toiyabe Range from east to west. Kingston Creek, in the canyon of the same name, is one of the largest streams in the Toiyabe Range; it has a fall of nearly 800 feet per mile. The district is accessible by automobile over fair desert roads from Austin, 30 miles to the north.

The first mineral discoveries were made here in 1863, and shortly afterward at least four amalgamating mills were erected in Kingston Canyon. These mills were unsuccessful owing to inadequate equipment and the lack of knowledge concerning the treatment of the ore. Later, a number of other mills were built in this area, the largest of which was erected about 1911 at the mouth of Kingston Canyon. This mill was equipped with 30 stamps and employed the cyanide process. It operated only a short time. The most important properties in the early days were known as the Phoenician and the Victorine.

A report by Raymond[14] written in 1875 is as follows:

> The Victorine mine shows a very large ledge, and the ore can undoubtedly be produced cheaply; but the present developments do not warrant a judgment as to its future. The milling of the ores of the vicinity in these mills has not given satisfaction, and could not well do so, on account of the want of a treatment consistent with the character of the ore. It is thought that these mines might fully supply a large mill, but the process employed should be one similar to the Washoe process.

No reliable statistics are available on the early production, but it probably exceeded $100,000. In early 1938 the only property active in the district was the Kingston group of claims.

Kingston Group

The Kingston group, comprising six patented claims owned by Joseph H. and Bernice E. Miller of Palo Alto, Calif., is on the north side of Kingston Canyon at an altitude of about 8,000 feet. This property is one of the early locations, and it has been worked intermittently for many years. Several years ago the property was taken over under bond and lease by S. H. Linka of Austin, Nev. Linka has mined about 650 tons of gold-silver ore, the bulk of which was of shipping grade.

14/ Raymond, Rossiter W., Report on the Mineral Resources of the States and Territories West of the Rocky Mountains: 1875, p. 239.

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Development includes two main adits, each about 700 feet in length, several inclines, and other scattered workings, totaling about 3,000 feet. Equipment includes a small compressor, blacksmith shop, camp buildings, and a small mill equipped with crusher, stamps, amalgamation plate, and concentrating table.

The prevailing formation is limestone, interbedded with siliceous shales and slates intruded by basic dikes. The ore occurs in two parallel quartz veins known as the Phoenician and the Morris, the latter being an extension of the Victorine. The veins are about 100 feet apart and have an irregular strike and dip conformable to the strike and dip of the enclosing sediments. The dip is generally flat, ranging from 22° to 30°, and the width of the veins ranges from 3 to 8 feet. The croppings are very prominent and traceable for a length of over 1 mile. The ore consists chiefly of gold and silver in a gangue of quartz stained with iron oxides. The oxidized zone extends to a depth of about 100 feet, below which the ore contains chalcopyrite, pyrite, galena, tetrahedrite, and gold in a quartz gangue. A shipment of ore from the Buckeye claim to the Nevada Consolidated Copper Co. smelter at McGill, Nev., made by S. H. Linka in June 1937, furnished the following data:

Metal quotation:	Gold	$35.00 per ounce	
	Silver	.77 per ounce	
		Ounces	
Settlement assay:	Gold	1.70	
	Silver	17.33	
		Percent	
	Silica	63.4	
	Alumina	5.7	
	Iron	.4	
	Lime	11.7	
		Pounds	
Net weight:		31,700	
Moisture, 3.42 percent		1,084	
Dry weight		30,616 or 15.308 tons	
Metal payment:	100 percent of gold at $32.897 per ounce		$55.92
	90 percent of silver at $0.766 per ounce		11.95
	Gross value per ton		67.87
Treatment charge:			6.00
	Net value per ton		61.87
	15.308 tons at $61.87	$947.11	
Deductions:	Sampling	7.65	
	Net proceeds	939.46	

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LEWIS DISTRICT

The Lewis district, also known as the Pittsburg, is in the vicinity of Lewis Canyon at the north side of the Shoshone Range, about 17 miles southeast of Battle Mountain, the nearest shipping point. It adjoins the Hilltop district on the northwest. Silver deposits were discovered here in 1867 by Jonothan Green and E. J. George, and in 1876 several stamp mills were erected in Lewis Canyon to treat ore from the Eagle and Starr Grove mines.

The gold deposits of the Pittsburg and Morning Star mine, discovered shortly after the silver deposits, were actively worked in the early days. The Pittsburg mine is on a ridge between Lewis and Krum Canyons. In the early eighties a pan amalgamation mill was erected in Krum Canyon and connected by a tramway with the mine, 1-1/2 miles distant. This mill operated until 1891. Judging from the size of the tailings pile and extent of the old stopes, a considerable tonnage of ore was treated. The Morning Star mine, adjoining the Pittsburg on the southwest, was sold to W. E. Dean of San Francisco, Calif., in 1892; he erected a 10-stamp amalgamating mill in Lewis Canyon. Litigation between Bewick, Moreing & Co., owners of the Pittsburg mine, and W. E. Dean resulted in a consolidation in 1904 of the two properties by W. E. Dean under the name of Cumberland mine. It is reported that Dean extracted enough ore from the old stopes in the Pittsburg mine to pay for the property. The Cumberland mine closed down in 1909 and remained idle until recent years.

The Betty O'Neal silver mine was opened as a prospect in 1880, and in 1882 production was $30,000 per month; the ore was treated at the Star Grove mill near the mouth of Lewis Canyon on a custom basis. A disastrous boiler explosion occurred at the mine in the fall of 1882. The mine was flooded and operations were discontinued. In 1920 N. H. Getchell acquired the property and organized the Betty O'Neal Mines Co. A 100-ton flotation mill was erected by the company in 1922, which operated for several years.

No accurate statistics are available on the production of the district prior to 1903, but from the fragmentary information, extent of old workings, size of the tailings piles, and reported value of the ore it is estimated to be at least $1,200,000, most of which was derived from the Pittsburg and Morning Star mines. The annual production from 1902 to 1936 is shown in table 6. During the period the Betty O'Neal mine has been the principal producer.

Cumberland Mine

The Cumberland or Dean mine, owned by the W. E. Dean estate of San Francisco, Calif., comprises a group of 12 patented claims. When the writer visited the property in April 1938 it was under bond and lease to C. B. Lancaster, who with several helpers was engaged in mining shipping ore.

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TABLE 6. - Gold, silver, copper, and lead production from Lewis District, Lander County, Nevada, 1902-1936, in terms of recovered metal

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Placer						Lode			
	No. of mines	Gold		Silver		Total value	No. of mines	Ore	Gold	
		Fine ounces	Value	Fine ounces	Value			Short tons	Fine ounces	Value
1902	-	-	-	-	-	-	1	2,664	950.66	$19,652
1903	-	-	-	-	-	-	1	1,822	854.69	17,668
1904-07	-	-	-	-	-	-	-	-	-	-
1908	-	-	-	-	-	-	1	5	-	-
1909	-	-	-	-	-	-	1	30	-	-
1910	-	-	-	-	-	-	1	4	2.64	55
1911-12	-	-	-	-	-	-	-	-	-	-
1913	-	-	-	-	-	-	1	111	1.19	25
1914	-	-	-	-	-	-	1	3	.06	1
1915	-	-	-	-	-	-	-	-	-	-
1916	-	-	-	-	-	-	1	1,720	.92	19
1917	-	-	-	-	-	-	1	1,200	3.20	66
1918	-	-	-	-	-	-	1	11	-	-
1919	-	-	-	-	-	-	1	41	-	-
1920	-	-	-	-	-	-	1	21	-	-
1921	-	-	-	-	-	-	2	18	12.47	258
1922	-	-	-	-	-	-	1	4,812	2.81	58
1923	-	-	-	-	-	-	2	38,209	126.81	2,621
1924	-	-	-	-	-	-	2	28,984	43.06	890
1925	-	-	-	-	-	-	2	23,293	38.91	804
1926	-	-	-	-	-	-	1	27,716	52.17	1,078
1927	-	-	-	-	-	-	1	26,314	64.47	1,333
1928	-	-	-	-	-	-	1	21,749	40.40	835
1929	-	-	-	-	-	-	2	11,164	23.05	476
1930	-	-	-	-	-	-	2	1,355	6.71	139
1931	-	-	-	-	-	-	3	113	54.10	1,118
1932	-	-	-	-	-	-	-	-	-	-
1933	-	-	-	-	-	-	1	36	-	-
1934	1	(2/)	(2/)	-	-	(2/)	3	665	62.53	2,185
1935	1	(2/)	(2/)	(2/)	(2/)	(2/)	4	715	65.43	2,290
1936	-	-	-	-	-	-	3	440	142.83	4,999
Total	-	10.09	$353	1	$ 1	$ 354	-	193,215	2,549.11	56,570

See footnotes on page 61

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TABLE 6. - Gold, silver, copper, and lead production from Lewis District, Lander County, Nevada, 1902-1936, in terms of recovered metal (Continued)

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode						Total value	Average recoverable value of ore per ton 1/	Total value (lode and placer)
	Silver		Copper		Lead				
	Fine ounces	Value	Pounds	Value	Pounds	Value			
1902	547	$290	-	-	-	-	$19,942	$7.49	$19,942
1903	420	227	-	-	-	-	17,895	9.82	17,895
1904-07	-	-	-	-	-	-	-	-	-
1908	536	284	-	-	-	-	284	56.80	284
1909	998	519	-	-	-	-	519	17.30	519
1910	1	1	-	-	-	-	56	14.00	56
1911-12	-	-	-	-	-	-	-	-	-
1913	14,872	8,983	-	-	-	-	9,008	81.15	9,008
1914	395	219	-	-	-	-	220	73.33	220
1915	-	-	-	-	-	-	-	-	-
1916	4,414	2,904	185	$46	493	$34	3,003	1.75	3,003
1917	9,370	7,721	945	258	1,367	118	8,163	5.80	8,163
1918	428	428	-	-	-	-	428	38.91	428
1919	2,432	2,724	399	74	-	-	2,798	68.24	2,798
1920	1,385	1,510	217	40	615	49	1,599	76.14	1,599
1921	107	107	-	-	-	-	365	20.28	365
1922	32,083	32,083	2,266	306	17,763	977	33,424	6.95	33,424
1923	661,847	542,714	48,295	7,099	279,780	19,585	572,019	14.97	572,019
1924	480,321	321,815	28,347	3,713	164,531	13,163	339,581	11.72	339,581
1925	571,156	396,382	31,784	4,513	183,629	15,976	417,675	17.93	417,675
1926	755,917	471,692	56,923	7,969	346,971	27,758	508,497	18.35	508,497
1927	774,739	439,277	52,961	6,938	314,256	19,798	467,346	17.76	467,346
1928	569,295	333,037	38,013	5,474	229,544	13,314	352,660	16.21	352,660
1929	201,604	107,455	22,541	3,967	76,108	4,795	116,693	10.45	116,693
1930	18,187	7,002	6,531	849	7,481	374	8,364	6.17	8,364
1931	629	183	411	37	1,927	71	1,409	12.47	1,409
1932	-	-	-	-	-	-	-	-	-
1933	5,274	1,846	460	29	1,370	51	1,926	53.50	1,926
1934	50,626	32,728	3,278	262	10,335	382	35,557	53.47	35,609
1935	40,432	29,060	2,741	227	14,138	568	32,145	44.96	32,447
1936	6,642	5,144	1,983	182	20,144	927	11,252	25.57	11,252
Total	4,204,657	2,746,335	298,280	41,983	1,670,502	117,940	2,962,828	15.33	2,963,182

1/ Not to be confused with average assay value of ore.

2/ Bureau of Mines not at liberty to publish figures but concealed figures included in totals.

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The Pittsburg vein is developed by seven adits and other workings totaling about 5,000 feet. The deepest working is about 550 feet. The Morning Star vein is developed by the Sconset and Mayo inclines, both 230 feet deep vertically; the Bousfield adit, 1,500 feet long, cutting the vein at the 460-foot level; the Dean or Cumberland adit, 3,000 feet long; an underground shaft 465 feet deep connecting the Bousfield and Cumberland adits; and other workings totaling about 2 miles. The Morning Star workings have a vertical range of 925 feet, but virtually all the ore from this vein was mined above the Bousfield adit or 460-foot level. Some of the workings are caved and inaccessible, and there is very little mining equipment on the property.

The country rock is silicified shale, quartzite, and granodiorite. Three veins occur on the property - the Morning Star, Pittsburg, and Cumberland.

The Morning Star vein is a fissure in granodiorite and quartzite striking nearly north and south and dipping 50° to 60° westward. Below the 380-foot level the vein splits into two branches, both branches reported to have carried good ore. On the 460-foot level the vein has six branches, some of which are barren. Ore occurs in shoots ranging from 1 to 10 feet in width. The principal ore shoot on the Morning Star vein between the Sconset and Mayo inclines is 300 feet long. The ore consists of free gold and a little galena and sphalerite in a gangue of quartz, pyrite, arsenopyrite, and subordinate amounts of calcite and barite. The smelter returns on a carload of ore sorted from the mine dumps and shipped to the American Smelting & Refining Co. by C. B. Lancaster on June 23, 1937, furnished the following data:

Metal quotations:	Gold	$34.9125 per ounce	
	Silver	.77 per ounce	
		Ounces	
Settlement assay:	Gold	0.70	
	Silver	1.35	
		Percent	
	Lead	0.8	
	Copper	nil	
		Pounds	
Wet weight		70,580	
Moisture, 2.4 percent		1,694	
Dry weight		68,886 or 34.443 tons	
Metal payment:	Gold, 100 percent at $31.81825 per ounce		$22.27
	Silver, 100 percent less 0.5 ounce		.65
	Gross value per ton		22.92

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Treatment charge;	Base charge	$3.00	
	10 percent of excess over $20	.29	
	Labor increase, 4/1/37	.59	$3.88
	Net value per ton		19.04
	34.443 tons at $19.04		655.79
Deductions:	Freight at $3.20 per ton	$112.93	
	Hauling at $3.25 per ton	114.69	
	Labor charge	6.00	
	Sampling	21.17	
	Assaying	3.00	257.79
	Net proceeds		398.00

The Pittsburg vein, also in granodiorite and quartzite, has a strike of S. 70° E., dipping southward 70°

The Cumberland vein, traceable on the surface for a distance of at least 500 feet, strikes S. 80° E. and dips southward about 45° It is a network of quartz seams, in places 20 feet wide, at the contact between shale and granodiorite. Very little development work has been done on the vein.

Several years ago the tailings from the Dean mill were located by Burt J. Kelley, since they were on the public domain. A small flotation mill was erected, and about 15,000 tons averaging $3 per ton was treated; but the venture was financially unsuccessful. The total tonnage of tailings available is about 35,000 tons. The tailings from the Pittsburg vein in Krum Canyon have been reworked several times by lessees.

Betty O'Neal Mine

The Betty O'Neal mine is on the west slope of the Shoshone Range 12 miles southeast of Battle Mountain. The property comprises a group of 36 patented and unpatented claims and other acreage owned by the Gold Circle Consolidated Mines Co. The mine attained its greatest production from 1923 to 1929, when it was operated by the Betty O'Neal Mines Co. This company completed the erection of a 100-ton flotation mill in November 1922, and in 1923 a second flotation unit was installed, doubling the capacity. Since 1929 the property has been worked intermittently, principally by lessees.

The mine is developed by five adits, a shaft 330 feet deep, a main drainage and transportation adit, which connects with the shaft at the 300-foot elevation at a point about 1,900 feet from the portal, and other underground workings totaling several miles and covering a range of 1,600 feet measured on the dip of the veins.

Equipment includes a 200-ton flotation mill, 15 horsepower, air hoist, two Chicago-Pneumatic, single-stage compressors, drill sharpener, storage-battery haulage equipment, machine shop, power plant, and living accomodations for a large crew. Power plant consists of two 300-horsepower Fairbanks-Morse,

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type Y, semi-Diesel engines each direct-connected to a type D Fairbanks-Morse alternator supplying current at 460 volts, 60 cycles.

Past mining operations have been confined to the Betty O'Neal and Estella veins, which strike nearly north and south, dip an average of 45° westward, and range from a few feet up to 55 feet in width. The ore bodies are of the replacement type in limestone and slate, cut by porphyry dikes. In places the limestone is highly silicified. The ore containing chiefly silver with a little copper and lead, is a mixture of silicified limestone and slate, fractured and recemented by calcite and quartz. The sulphide ore minerals are tetrahedrite, stephanite, argentite, polybasite, galena, pyrite, and sphalerite. In the oxidized ore near the surface the principal silver mineral is cerargyrite associated with copper in the form of malachite and azurite.

McCOY DISTRICT

The McCoy district is in the low, rolling hills on the west side of Reese River Valley 32 miles by automobile road south 35° east from Battle Mountain, the nearest shipping point and supply center. Gold was discovered here in 1914 by Joseph H. McCoy, who with others located a number of claims in a mineralized area about 1-1/2 miles long and 3/4 mile wide. Desultory prospecting followed for a number of years, but no ore was produced until about 1928, when, stimulated by the discovery of high-grade gold ore, a small boom ensued. In 1930 and 1931 the camp had a population of about 75 people. Mining activity gradually subsided, so that at the time of the writer's visit in April 1938 there was no mining activity in the district and the camp was almost deserted.

The production of the district has been about $35,000, most of which was shipping ore mined from the Gold Dome property, which includes the Iron King claim, upon which the original discovery of gold was made.

Nevada Gold Dome Mining Co.

The Nevada Gold Dome Mining Co. comprises a group of 17 unpatented claims controlled by H. D. Brown, Jr., of Los Angeles, Calif. It includes the original discovery claims acquired by the present company in 1928. A 20-ton amalgamation mill was erected in 1930, but it operated only a few months. Production from the Gold Dome property, as compiled by the writer from the smelter and mint shipments, has been 468 tons of ore with a gross smelter value of $26,863.62, an average of $57.37 per ton; the bullion had a value of $5,391.07.

Principal development has been from the Dome 1-1/2-compartment vertical shaft 265 feet deep, from which levels have been cut at the 50-, 100-, 150-, 200-, 250- and 265-foot points below the collar. Workings total approximately 1,200 feet. Equipment includes a blacksmith shop, tools, a single-drum gasoline hoist, a Gardner-Rix 160 cubic-foot compressor belt-driven by a Novo gasoline engine, a camp building, and a partly equipped mill. The mill is equipped with a jaw crusher, (9 by 16 inches), a ball mill (4 by 5 feet), and

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a Gibson impact amalgamator. Power for milling is supplied by a caterpillar Diesel engine. Water for milling is obtained from Wellman Spring, 3/4 mile from the mill, through a 2-inch gravity-flow pipe line.

The formation is chiefly limestone intruded by diorite and quartzite. In places the limestone has been altered by contact metamorphism to tactite composed chiefly of garnet, epidote, and nontronite. The gold is erratically distributed in replacement and contact metamorphic deposits. A number of samples of the contact metamorphic material were taken by the writer and assayed for tungsten, but no tungsten was found. The ore minerals are gold, cerargyrite, copper carbonates, cerussite, pyrite, and galena in a gangue of quartz, iron oxide, jasper, calcite, and altered country rock. The smelter returns on the last shipment of ore made by Mrs. Florence McCoy on April 5, 1932, to the American Smelting & Refining Co. were as follows:

Metal quotations:	Gold	$20.67 ounce	
	Silver	.29708 ounce	
		Ounces	
Settlement Assay:	Gold	1.615	
	Silver	9.1	
		Percent	
	Lead	1.3	
	Insoluble	58.0	
	Iron	15.7	
	Lime	.3	
		Pounds	
Wet weight:		58,240	
Moisture, 14.3 percent		8,328	
Dry weight		49,912 or 24.956 tons	
Metal payment:	100 percent of gold at $19.50		$31.49
	95 percent of silver at $0.29708		2.57
	Gross value per ton		34.06
Treatment charge:			3.50
	Net value per ton		30.56
	24.956 tons at $30.56		762.66
Deductions:	Freight advanced $6.86 per ton		199.76
	Net proceeds		562.90

NEW PASS DISTRICT

The New Pass district is on the east slope of the New Pass Range near the boundary line of Lander and Churchill Counties, 31 miles west of Austin. Gold was discovered here by A. Monroe, Tom Plane, and others from Austin in the fall of 1865. In 1868 a 5-stamp amalgamation mill operated by steam was erected at Warm Springs several miles east of the mine. This mill operated for several years and treated about 12,000 tons of ore. About 1917 the Austin

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New Pass Mining Co. acquired the principal mine and erected a 75-ton cyanide mill, but the operations were unsuccessful and the property was sold to W. C. Pitt of Lovelock to satisfy a mortgage. In recent years there has been only small-scale activity in the district.

No accurate production statistics are available, but output probably has exceeded $200,000, most of which was derived from the Pitt mine now owned by the Nupaz Mining Co.

Nupaz Mining Co.

The Nupaz Mining Co., F. M. Lovell, 1025 W. Fourth St., Los Angeles, Calif., president, owns a group of 13 claims, 8 of which are patented, and 1 patented millsite. This property was last worked about 1931 by Andrew Drum of Fallon, Nev.

Development consists of three main adits, the longest of which is 1,500 feet, a shaft 350 feet deep, and other workings totaling about 5,000 feet. The vertical range of the workings is about 350 feet. There is no mining equipment on the property. The cyanide plant and pipe line have been dismantled and the equipment has been sold. Water for milling was obtained from Gilbert Springs through a gravity pipe line about 6 miles long.

Two veins, the Superior and Gold Belt, occur in diorite. The Superior, the principal vein, strikes N. 10° W. and dips about 75° westward. The average width is about 3 feet. The ore is chiefly free gold in a quartz gangue; that milled in former years is reported to have yielded $9 to $14 per ton.

The tailings pile at Warm Springs originally contained about 12,000 tons, but a large proportion has been scattered by winds. Several thousand tons of tailings remaining have been sampled and are said to average $2 of gold per ton.

Thomas W. Mine

The Thomas W. mine comprises a group of five unpatented claims owned by Wayne H. Smyth and Howard Snyder of Austin, Nev. This property is on the Gold Belt vein and adjoins the property of the Nupaz Mining Co. Prior to the writer's visit in May 1938, the owners had worked the mine for several years, treating the ore in a small amalgamation mill at the mine. The production of bullion for the 2-year period was about $14,000.

Development consists of two shafts, each about 125 feet deep, and about 500 feet of subsidiary workings, principally on the vein. In May 1938 one of the shafts was being sunk to the 225-foot level. Equipment includes a gasoline hoist, a Fairbanks-Morse compressor (8 by 8 inches), blacksmith shop, a camp building, and an amalgamation mill equipped with Blake-type crusher (20 by 9 inches), an amalgamation plate 10 feet long and 4 feet wide, five stamps (1,150 pounds each) fed by Challenge feeder, a Washoe amalgamating pan (4 feet in diameter), and a Fairbanks-Morse 20-horsepower crude-oil engine.

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Water for milling is obtained from two wells about 1 mile from the mine; it is pumped to the mill through a 2-inch pipe line by two plunger pumps each connected to a 3-horsepower, Fairbanks-Morse, Z-type gasoline engine.

Prevailing formation is silicified limestone and diorite. The Gold Belt vein strikes N. 15° W. and dips nearly vertical. The width ranges from 1 to 3 feet, and the gold is associated with small amounts of galena, copper, and lead carbonates in a quartz gangue. The vein is displaced for short distances by several faults. The grade of the ore milled ranged from $30 to $40 per ton. From 85 to 90 percent of the gold in the ore was recovered by amalgamation.

Happy Days Group

The Happy Days group of two unpatented claims owned by George Partenico is about 3 miles westerly from Warm Springs and 1 mile southeast of the New Pass mine. This property has been worked intermittently on a small scale for shipping ore, but production has been small. Several years ago Partenico erected a small Kincaid amalgamation mill at the mine in which a small tonnage was treated.

Development consists of a shaft 200 feet deep, a shaft 85 feet deep, and lateral workings totaling 300 feet more. Equipment includes a small, partly equipped mill, a home-made hoist, a blacksmith shop, and a camp building.

The prevailing formation is shale. Ore occurs in small lenses in a vein striking N. 25° W. and dipping 60° northeasterly near the surface and at depth nearly vertical. The vein is crushed and disturbed by numerous faults. The ore contains gold, with minor amounts of silver, in a gangue composed chiefly of quartz.

Manganese Deposit

A deposit of manganese occurs on the west side of Antelope Valley about 5 miles north of Warm Springs. The only locations are two unpatented claims owned by L. A. Merrigan of Reno, Nev. This deposit was discovered about 20 years ago. Very little work has been done, and no manganese has been produced.

Manganese associated with considerable siliceous material is present in two veins up to 20 feet in width in an igneous formation. One vein is traceable on the surface for about 300 feet. A representative sample yielded 25 percent manganese and 50 cents in gold per ton.

RAVENSWOOD DISTRICT

The Ravenswood district is in the Ravenswood Range of mountains about 25 miles northwest of Austin. It was organized in 1863, when many locations were made for silver but the veins were found to contain mostly copper, and after a short period of activity the disappointed prospectors withdrew. Except for desultory prospecting, there has been no activity in this area for many years. Several carloads of shipping ore have been mined.

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According to Hill[15] the ores are in small lenselike quartz veins, which in the sulphide zone carry chalcopyrite, galena, and tetrahedrite associated with silver, and a little gold. The country rocks are quartzite, shale, and limestone.

A manganese deposit near Carico Dry Lake and deposits of volcanic ash in Reese River Valley are included in the Ravenswood district for convenience.

Volcanic Ash

Volcanic ash outcrops in the low hills in Reese River Valley along both sides of the Reese River for 12 miles between points 23 to 35 miles north of Austin, Nev. A large deposit is owned by H. W. Rast of Austin. The only production has been one carload that was shipped from the Rast deposit to Los Angeles in 1929 for experimental purposes. The nearest shipping point is Battle Mountain, about 30 miles north.

The ash is in flat-dipping stratified beds that strike north and south and are overlain by detrital material. The beds have a general strike of north and south, and those on the west side of the valley dip westward while those on the east side dip to the east. The thickness of the beds ranges from a few feet to a maximum of 15 feet. The material is composed largely of fine grains of silica, slightly coherent, gray in color, and uniform in size and texture. An analysis made by the University of Nevada indicates that the material is principally silica with minor amounts of iron, alumina, and lime. It is probably suitable for the manufacture of household cleansers, mechanics' soap, and other mild abrasives, but the distance from consuming centers prohibits its use at present in competition with other deposits more strategically situated.

Manganese Deposit

Manganese occurs in the vicinity of Carico Dry Lake 50 miles north of Austin. The deposit is covered by two unpatented claims owned by H. W. Rast and Ignacio Aberasturi of Austin. No work has been done on the deposit.

The manganese covers the top of a small hill and the croppings are about 300 feet long by about 200 feet wide. It is associated with considerable siliceous material and is probably too low-grade to be of economic importance at present. A 50-pound sample taken by the writer contained 10.3 percent manganese.

REESE RIVER DISTRICT

The Reese River district is near the town of Austin on the west slope of the Toiyabe Range in southern Lander County. It lies in Pony Canyon between Lander and Union Hills, upon which the principal mines are situated. As originally organized, the district was 75 miles long by 20 miles wide, but in recent years the limits have been restricted to an area about 8 miles long

15/ Hill, J. M., Notes on Some Mining Districts in Eastern Nevada: Geol. Survey Bull. 648, 1916, pp. 105-113.

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extending from Miguel Canyon on the south to Amador on the north, and about 1 mile in width. Within this area is a belt containing silver-bearing veins; the greater part of the ore, however, has been derived from an area about 1/2 mile square. Austin, the county seat of Lander County, is on the Lincoln Highway (United States Route 50), and it is in the geographical center of the State. The altitude of the mines ranges from 6,500 to 7,000 feet.

Silver ore was discovered on May 2, 1862, by William H. Talcott, an employee of the Overland stage stationed at Jacobsville, about 7-1/2 miles west of the present site of Austin. This discovery created considerable excitement, and a great many people flocked into the area. Lander County was organized December 19, 1862, and the first county seat was Jacobsville, which by 1863 had a population of 300, 2 hotels, 3 stores, post office, telegraph office, and 50 residences. There is nothing left at present to indicate that Jacobsville once was a thriving community. By a vote of the people of the county, Austin became the county seat in September 1863. Immigration to the district reached its height in 1863, when Austin had a population of over 6,000, 3 banks, 360 houses and a large number of squatter tents, 5 clergymen, 12 physicians, 33 lawyers, and several public and private schools.

During the first 2 years of the camp's history the greatest excitement prevailed regarding the richness of the mines; at least 6,000 claims were located on the public domain, hundreds of which were sold for fabulous prices when little or no work had been done on them. Many of these later proved to be worthless. The first mill was erected by D. C. Buel in the latter part of 1863, followed by numerous others, so that by 1866 there were 20 stamp mills in the district equipped with a total of 219 stamps. Most of these mills were like the mills of the gods, in that they ground slowly, but many of them were built before there was any ore to treat. The total production of the district up to January 1864 was about $100,000.

In 1865 the Manhattan Silver Mining Co. began to consolidate the principal mines in the district by purchasing adjoining properties, so that by 1870 it controlled nearly all the mines on Lander and Union Hills. This consolidation was essential, since endless litigation over apex rights would have retarded the development of the mines. This company also purchased custom ores, so that from 1870 to 1887 it produced most of the output. In 1873 the company owned the largest mining property in the State, which included 68 claims, a 20-stamp mill, a Stedefeldt furnace for chlorination with 8 pan amalgamators and 8 settlers, 10 hoisting and 2 Cornish pumping steam engines totaling 220 horsepower, with three 6-inch-column Cornish pumps. According to the original bullion record, this company produced $19,239,033 up to 1887, nearly all of which was silver. In 1886 the Manhattan Silver Mining Co. was reorganized under a new management and the capital stock was increased from 1,000,000 to 5,000,000 shares. The following year the property was attached by unpaid employees.

In 1888 an attempt was made to work the property by a company called the Manhattan Mining & Reduction Co. After working the dumps and mining some ore from the Union mine, the company closed in 1890. In 1891 the property was

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acquired by the Austin Mining Co., controlled by the J. G. Phelps Stokes interests of New York. During the next 10 years this company acquired additional ground and drove the Austin-Manhattan drainage and haulage adit to explore the veins on Lander Hill at depth. This adit has its portal in Pony Canyon near the site of the former railroad station; it was 5,985 feet in length with a lateral crosscut 2,900 feet long branching off at a point 3,855 feet from the portal. A 40-stamp concentrating mill was also built near the portal of the Austin-Manhattan adit, in which some ore was milled. Several transfers of the property took place between 1904 and 1908, when the Austin Manhattan Consolidated Mining Co. obtained possession. This company rehabilitated some of the old mines and produced some ore. In 1910 a concentrating plant was erected at the lower end of Pony Canyon and was put in operation the same year. The mill equipment included six Huff electrostatic separators, two crushers, and two concentrating tables. The mill is said to have been unsuccessful, and in 1920 the company passed into the hands of a receiver.

Except for sporadic leasing operations, there was very little activity in the district between 1911 and 1935. In 1935 nearly all of the old productive mines adjacent to the town of Austin were acquired by the Austin Silver Mining Co., which has since been operating in the district.

In addition to the Austin Silver Mining Co. holdings, a number of other groups of claims are owned chiefly by individuals. During the past 40 years a number of small companies have been organized from time to time to work mines in the district, but all of these were short-lived.

The production of the district from 1862 to 1903 is estimated by the writer, from the data available, to have been about $26,000,000. The production from 1902 to 1936, inclusive, was $332,097, chiefly silver, with some gold and a little lead and copper. The annual production for the district from 1902 to 1936 is shown in table 7.

The geology of the Reese River district has been described by Emmons[16] and by Hill[17].

Early-Day Metallurgy and Mining

In the early days of the Reese River district attempts were made to treat the ores by the Washoe process as developed on the Comstock lode, but, as the ores were refractory, the results were generally unsuccessful. The Washoe process consisted of wet-crushing in stamps followed by amalgamation in various types of iron pans. As more information on the character of the ores was obtained, the Reese River process was developed. This consisted of dry-crushing with stamps and a chloridizing roast, followed by amalgamation as in the Washoe process. Chlorination was not essentially new, since the extraction of gold by leaching with chlorine gas was first used by Plattner at Freiberg, Germany, some years previous; it was first introduced into the United States by G. W. Deetken at the Eureka and Idaho mills of Grass Valley, Calif., in 1857. The Reese River process was applicable to silver ores containing arsenical and antimonial sulphides, and the object of roasting was to convert the sulphides into chlorides, so that precious metals could be recovered by amalgamation.

16/ Emmons, S. F., Geology of the Toiyabe Range: Geological Exploration of the Fortieth Parallel, Washington, D. C., 1870, pp. 320-348.
17/ Hill, James M., Some Mining Districts in Northeastern California and Northwestern Nevada: Geol. Survey Bull. 594, 1915, pp. 95-114.

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TABLE 7. - Gold, silver, copper, and lead production from Reese River District, Lander County, Nevada, 1902-1936, in terms of recovered metal

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Placer						Lode			
	No. of mines	Gold		Silver		Total value	No. of mines	Ore	Gold	
		Fine ounces	Value	Fine ounces	Value			Short tons	Fine ounces	Value
1902	-	-	-	-	-	-	1	50	26.60	$550
1903-04	-	-	-	-	-	-	-	-	-	-
1905	-	-	-	-	-	-	3	205	77.64	1,605
1906	-	-	-	-	-	-	4	193	54.71	1,131
1907	-	-	-	-	-	-	2	586	32.26	667
1908	-	-	-	-	-	-	10	161	65.55	1,355
1909	-	-	-	-	-	-	3	618	158.28	3,272
1910	-	-	-	-	-	-	6	674	182.11	3,765
1911	-	-	-	-	-	-	7	3,043	1,054.61	21,801
1912	-	-	-	-	-	-	8	86	76.25	1,576
1913	-	-	-	-	-	-	8	3,952	199.44	4,123
1914	-	-	-	-	-	-	4	3,015	12.22	253
1915	-	-	-	-	-	-	4	63	12.79	264
1916	-	-	-	-	-	-	2	78	.20	4
1917	-	-	-	-	-	-	7	101	7.50	155
1918	-	-	-	-	-	-	9	107	54.96	1,136
1919	-	-	-	-	-	-	4	55	2.54	53
1920	-	-	-	-	-	-	5	121	33.13	685
1921	-	-	-	-	-	-	3	18	2.79	58
1922	-	-	-	-	-	-	2	52	32.07	663
1923	-	-	-	-	-	-	2	9	1.35	28
1924	-	-	-	-	-	-	2	231	9.66	200
1925	-	-	-	-	-	-	1	1	1.01	21
1926	-	-	-	-	-	-	2	40	18.20	376
1927	1	1.71	$35	2	$1	$36	4	42	6.65	137
1928-29	-	-	-	-	-	-	-	-	-	-
1930	-	-	-	-	-	-	2	28	14.25	295
1931	-	-	-	-	-	-	-	-	-	-
1932	-	-	-	-	-	-	1	36	40.14	830
1933	1	1.56	40	-	-	40	3	7	12.25	313
1934	-	-	-	-	-	-	5	12	7.92	277
1935	-	-	-	-	-	-	8	966	33.51	1,173
1936	-	-	-	-	-	-	8	7,682	79.50	2,783
Total	-	3.27	75	2	$1	76	-	22,232	2,310.09	49,549

See footnote on page 72

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TABLE 7. - Gold, silver, copper, and lead production from Reese River District, Lander County, Nevada, 1902-1936, in terms of recovered metal (Continued)

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode								Total value (lode and placer)
	Silver		Copper		Lead		Total value	Average recoverable value of ore per ton 1/	
	Fine ounces	Value	Pounds	Value	Pounds	Value			
1902	-	-	-	-	-	-	$550	$11.00	$550
1903-04	-	-	-	-	-	-	-	-	-
1905	22,321	$13,482	-	-	-	-	15,087	73.60	15,087
1906	54,634	36,605	3,109	$600	14,000	$798	39,134	202.77	39,134
1907	27,788	18,340	2,640	528	-	-	19,535	33.34	19,535
1908	15,953	8,455	212	28	6,691	281	10,119	62.85	10,119
1909	9,127	4,746	1,562	203	19,837	853	9,074	14.68	9,074
1910	27,159	14,665	6,797	863	72,076	3,172	22,465	33.33	22,465
1911	101,592	53,844	1,972	246	29,067	1,308	77,199	25.37	77,199
1912	3,390	2,085	12	2	47	2	3,665	42.62	3,665
1913	18,246	11,021	348	54	922	40	15,238	3.86	15,238
1914	12,783	7,069	104	14	4,076	159	7,495	2.49	7,495
1915	4,745	2,406	96	17	-	-	2,687	42.65	2,687
1916	3,707	2,439	121	30	-	-	2,473	31.71	2,473
1917	3,455	2,847	284	78	10,476	900	3,980	39.41	3,980
1918	7,638	7,638	181	45	3,227	229	9,048	84.56	9,048
1919	4,013	4,495	35	7	43	2	4,557	82.85	4,557
1920	8,810	9,603	153	28	3,754	300	10,616	87.74	10,616
1921	2,575	2,575	225	29	1,563	70	2,732	151.78	2,732
1922	4,972	4,972	39	5	124	7	5,647	108.60	5,647
1923	984	807	-	-	-	-	835	92.78	835
1924	2,571	1,723	-	-	3,009	241	2,164	9.37	2,164
1925	1	1	-	-	-	-	22	22.00	22
1926	1,300	811	-	-	-	-	1,187	29.68	1,187
1927	7,134	4,045	652	86	3,934	248	4,516	107.52	4,552
1928-29	-	-	-	-	-	-	-	-	-
1930	1,647	634	-	-	-	-	929	33.18	929
1931	-	-	-	-	-	-	-	-	-
1932	384	108	-	-	363	11	949	26.36	949
1933	223	78	-	-	56	2	393	56.14	433
1934	4,554	2,944	101	8	311	12	3,241	270.08	3,241
1935	16,179	11,629	647	54	14,702	588	13,444	13.92	13,444
1936	51,504	39,890	1,869	172	5,897	271	43,116	5.61	43,116
Total	419,389	269,957	21,159	3,097	194,175	9,494	332,097	14.94	332,173

1/ Not to be confused with average assay value of ore.

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At first, reverberatory furnaces having either one or two hearths, imported from Europe, were used. Because of their limited capacity and the skill required in their manipulation, a number of mechanical roasters were invented, including the White, Bruckner, Howell, and Stetefeldt. The last was an important contribution to the metallurgy of refractory silver ores, not only at Reese River but in other districts in the West. C. A. Stetefeldt discovered that silver ores mixed with salt are completely chloridized if they fall against a current of hot air rising in a shaft with no obstructions whatever to check or retard the fall of the ore particles. Instead of requiring from 4 to 8 hours to chloridize the ore, as in the reverberatory furnaces, it was done in the Stetefeldt furnace in a few seconds. The first experiments with this furnace were made in the Murphy mill, Ophir Canyon, Nev., in 1867, and in 1870 a Stetefeldt furnace was erected by the Manhattan Silver Mining Co. at Austin. This company had the exclusive right to the use of the furnace in the district and paid a royalty of $2 per ton. It was so superior in economy and operation to others then used that it gave the company a virtual monopoly on the milling of ores in the district. The gain in the treatment of rich ore amounted in some cases to as much as $20 per ton.

The Stetefeldt furnace was heated by gases produced from charcoal in two gas generators. A third generator produced gases for heating and chloridizing the dust, which was drawn by a strong draft into the main flue. The height of the furnace from cooling floor to the hopper was 30 feet; and the pulverized ore mixed with salt fell against the flame for a distance of 18 feet. A description of the furnace used by the Manhattan Silver Mining Co. is given by Raymond[18/].

> The flame from the generators enters the furnace a little over 6 feet above the cooling floor, and the bottom of the flue above is 4-1/2 feet below the top. The inside size of the shaft at its lower end is 5 feet square. The bottom inclines toward the discharge door and tapers toward the top, where the size of the shaft is 3-1/2 feet square. The finely divided ore sifts into the furnace in a continual shower by a special feeding arrangement.
>
> A very expensive system of dust chambers is connected with the furnace. As the dust has to pass the fireplace in the main flue before it can reach them, the ore found here is the most perfectly roasted. From the dust chambers the waste heat passes under the large dry kiln and thence into the chimney. For the first month the cost of roasting was $6.48 per ton as compared with $15.34 per ton in the reverberatories previously used.

After being roasted, the ore was fed to amalgamating pans holding a charge of about 1,000 pounds. Sufficient water was added to the charge to bring the pulp to the desired consistency; each pan was equipped with an iron muller, which revolved at a speed of about 40 revolutions per minute to break up the lumps and agitate the material. Quicksilver was added after the pulp had been stirred enough, the amount depending on the grade of the ore. The stirring continued for about 6 hours, when the charge was run into a settler similar in design to the amalgamating pan, but with stirrers made of wood. The fluid

18/ Raymond, Rossiter W., Mineral Resources in States and Territories West of the Rocky Mountains (1870): Washington, D. C., 1872, p. 119.

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amalgam was collected from the settlers, strained to eliminate the excess mercury, and the amalgam was retorted. The bullion averaged about 700 fine; the loss of quicksilver was approximately 1-1/2 pounds per ton of ore worked. The power for milling was furnished by steam engines. Wood for fuel was chiefly pinon pine obtained locally.

The Manhattan mill had 20 stamps, which operated dry. By chloridizing roasting in the Stetefeldt furnace and amalgamation, about 90 percent of the assay value was recovered on ore averaging about $230 per ton.

The annual report by the Board of Trustees of the Manhattan Silver Mining Co. for the year 1873 contained the following interesting data on mining and milling costs.

From Oregon and North Star mines:

2,287.25 tons ore, producing $224.50 per ton		$513,487.63
Milling expenses ($34.99 per ton)	$80,030.88	
Mining expenses ($78.26 per ton)	179,010.19	259,041.07
		254,446.56

From other mines:

696.75 tons, producing $212.72 per ton		148,212.66
Milling expenses ($34.99 per ton)	24,379.28	
Mining expenses ($137.31 per ton)	95,670.74	120,050.02
		28,162.64
Profit on custom ores:		
1,674.5 tons at $27.74 per ton		46,450.63
Profit for 1873		329,059.83

The cost per ton for reduction of the ores during 1874 was distributed as follows:

Labor	$9.35
Fuel	10.12
Supplies	2.06
Quicksilver	2.75
Salt	2.72
Official labor	1.17
Castings	1.99
Hauling	1.35
Total per ton	31.51

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The cost of labor and supplies was not particularly high, considering the isolation of the region and the poor transportation facilities, and in the light of present-day metallurgical knowledge it is difficult to justify such extremely high mining and milling costs. Some data on the cost of labor in 1870, as given by Raymond[19], were as follows:

Wages for first class miners.....	$4 per day.
Wages for surface laborers.....	$4 per day.
Cost of lumber.....	$120 per M.
Cost of mining timber.....	$0.75 for post 6 inches diameter by 6 feet long.
Cost of common powder.....	$22 to $26 per 100 pounds.
Cost of giant powder.....	$1.40 to $1.40 to $1.50 per pound.
Cost of quicksilver.....	$0.67 per pound.
Cost of freight from Argenta.....	$0.02 per pound.
Cost of fuel (locally cut).....	$9 to $11 per cord.
Cost of 10-stamp mill, California pattern, including freight, erection, etc.	$40,000 to $50,000
Cost of 20-stamp mill, California pattern; including freight, erection, etc.	$75,000 to $100,000

Salt was an essential item in the reduction of the Reese River ores, and fortunately it existed in great abundance within convenient distances from the mines. The salt was obtained from the desert playas, the principal source of supply being Spaulding Salt Marsh in Smoky Valley 35 miles south of Austin. Here the salt was gathered from the surface, and it required no purification before use. Laid down at Austin, the cost ranged from $30 to $40 per ton. The salt required for chlorination amounted to about 10 percent of the weight of the ore.

A large proportion of the ore in the district was milled on a custom basis. In the first years of the camp's history the milling cost was $75 per ton, but this cost was reduced in 1866 to $45 per ton. A contemporary newspaper[20] contained the following editorial on milling costs:

> One of the greatest drawbacks to the development of a large number of mines in this and other districts has been the excessively high rate of reductions. Ore that was worth $50 to $75 per ton would not pay the owner for extraction, and the miners generally concluded that it had better be allowed to remain in its native matrix. In today's issue, Capt. A. L. Page, general superintendent of the Keystone mill and mines, agrees to reduce ores in lots of 20 tons and upwards at $45 per ton, and smaller lots at the rate of $50 per ton; and he guarantees to pay 80 percent of the assay value of the pulp on each particular lot of ore. This will be stirring news to our miners and will cause many an idle mine to bring forth fair fruit of silver.

19/ Raymond, Rossiter W., Mines and Mining in States and Territories West of the Rocky Mountains (1870): Washington, D. C., 1871, pp. 139-140.
20/ Reese River Reveille, Apr. 21, 1866.

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> Hitherto miners have complained, we think justly, that the mill charges were excessively high and completely absorbed the values of their ores, and as their labor was unremunerative they were forced to close their mines. Captain Page has proposed a handsome proposition, and if the miners will reopen their claims and work earnestly and systematically a better state of mining will be brought about and something like a proper spirit of co-operation will pervade the relation of mine and mill.

The Keystone mill, erected in 1865, was equipped with 20 750-pound stamps, 8 reverberatory furnaces with hearths 11 by 13 feet, 14 pan amalgamators 5 feet in diameter, and 6 settlers 6 feet in diameter.

After the Manhattan Silver Mining Co. obtained a milling monopoly in the district by the exclusive use of the Stetefeldt furnace, the custom milling charges were reduced to $35 per ton; 80 percent of the assay value was allowed on ores assaying $400 or less, and 82 percent on ores assaying over $400 per ton. These rates remained in effect during the period when the district made its greatest production.

A Krom dry concentrator was installed by the Manhattan Co. in 1875 as an adjunct to milling operations but was unsuccessful. Subsequently the Wren process, discovered and patented by Thomas Wren, one of the pioneers of the district, was installed. This process was based largely upon a separation by screening, on the principle that the metallic particles in the ore were reduced by crushing to a finer state of division than the gangue, so that a rough concentration could be effected. Gravity concentration with water also constituted part of the process.

Although the Reese River process was very inefficient compared with modern metallurgical practice, it constituted an important advance in metallurgy.

The earliest mining in the district appears to have been more a random hit-or-miss proposition than a well-directed effort at practical mining. Prior to the acquisition of the principal properties in the district by the Manhattan Silver Mining Co. in 1870, the mines were worked by a number of individual owners. The large number of small claims and the faulted condition of the network of narrow but rich veins in a limited area were fruitful sources of litigation. Speaking of this condition of affairs, Raymond[21] states:

> One of the greatest obstacles in the way of successful mining in the Reese River district is the great number of small veins claimed by different individuals. Each mine is generally worked by itself, and sometimes there is hardly room on the surface for the necessary buildings and dumps. On Lander Hill, there is one place where, within a space of about 1 acre, there are five different hoisting works belonging to different owners. This is obviously a very expensive and inconvenient way of working mines. Again, it is not always practicable to keep reserves ahead with

[21] Raymond, Rossiter W., Mines and Mining in the States and Territories West of the Rocky Mountains (1870): Washington, D. C., 1871. p. 132.

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one small vein, especially in cases where mine and mill are owned by the same party. Ore must be obtained for the mill; and if, in prospecting ahead, a barren spot is reached, the known reserves must be attacked to supply the deficiency. In working large veins or many small veins this difficulty is not felt. If one vein is temporarily barren, there are others to fall back upon. Much better work at much less expense could be done on Lander Hill if one company owned a large number of parallel or contiguous claims and worked them through one or two shafts or through a deep tunnel.

With reference to mining costs, Raymond[22] states:

> The mining cost per ton of ore varies excessively according to the width of the vein and the hardness of the ground. In the Manhattan, I believe, it has been as high as $50 per ton; and, indeed, the average cost per ton for the year ending July 1, 1869, at that mine (all expenses except dead work included) was over $51. Other mines on Lander Hill are not likely to have been much better off.

Part of the high mining costs is attributable to the fact that the veins were narrow and the ores were generally hand-sorted twice - once in the mine and again at the surface. The veins were so narrow that the early miners facetiously referred to them as "razor blades", "shoe strings", or "paper cutters". After 1870 most of the ore was mined by the leasing system with general satisfaction to both the mine owners and contractors. In regard to the introduction of the tribute or leasing system, a report written in January 1873 by J. E. Clayton for the Manhattan Silver Mining Co. contains the following:

> During the years 1868-1869, the company had much difficulty in procuring efficient labor. This was owing to two causes: (1) The discovery of the White Pine and Pioche mines drew off a large portion of the best miners, leaving a very indifferent class of workmen in this district; and (2) the veins being small and the underground work being much spread out and scattered, it was found to be impossible to get faithful, honest work done. These difficulties appeared at one time to be almost fatal to the success of the enterprise, but they were overcome by a radical change in the labor management. This was effected by the adoption of the contract and tribute system for all underground work. This change could not be made suddenly without a large falling off of the production of the mines, but the company contented itself with doing custom work in their mill and allowing the work on its own mines to lie comparatively idle. The miners, however, gradually became reconciled to the change, and the work of development and consequent yield of the mines were gradually increased during the last two years. The present tribute system has become established, and a good supply of Cornish miners is now settled in the district.

22/ Work cited, page 140.

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In stoping ore, lessees or tributers were paid a percentage of the values recovered. Some leases were let with a royalty as low as 7 percent of the gross yield, and the ores were so rich that the lessees were able to realize large profits for their labor. In unproductive ground the lessees were paid a stipulated price per foot, which was regulated according to the character of the ground and working conditions. The rate for drifts was generally $1.50 per foot and for crosscuts $2, the workmen furnishing all supplies and receiving 50 percent of the net value of any ore mined during the progress of the work. The system was undoubtedly a good one, as the contractors became interested in the workings and carried on operations with greater vigor and economy than would have been possible under company account. The veins were worked by resuing.

Chinese workers were brought into the district in the seventies. The experience of the Central Pacific Railroad, which employed many Chinese in the construction of the road across Nevada, first called attention to the qualifications of the Chinese as miners. A number of attempts were made to employ Chinese labor but the results were generally unsuccessful due to the hostility of other miners or to the difficulty of managing the Chinese.

The hoisting plants at the mines were steam-driven. Water found in the mines at a depth of about 75 feet from the surface was handled by steam-driven Cornish pumps.

Austin Silver Mining Co.

The Austin Silver Mining Co., a Nevada corporation with a capitalization of 1,000,000 shares, par value $1, controls a large group of patented and unpatented claims in the heart of the Reese River district. The company holdings include nearly all of the principal producing mines of former years. Operations were begun about 3 years ago, and up to May 1938 about 25,000 tons of ore had been treated in the company-owned mill. In May 1938 mining operations were discontinued temporarily, except for a little development work in the Camargo workings and several leasing operations at the Jack Pot mine.

Development includes a number of shafts, inclines, and lateral workings totaling about 15 miles. Many of the workings are caved and inaccessible. The Austin-Manhattan adit cuts the Frost shaft on Lander Hill at a depth of 660 feet below the collar. The deepest workings attain a depth of about 700 feet. Equipment includes a 100-ton flotation mill erected in 1935 near the portal of the Austin-Manhattan adit. The mill is equipped with two crushers, an Eimco Ball mill (5 by 6 feet), duplex classifier, seven Fagergren flotation cells, filter, oil-fired pans and rotary drier for concentrates, and an assay office. The Camargo workings are equipped with a 25 horsepower Fairbanks-Morse geared hoist, a Gardner single-stage compressor belt driven by a gasoline engine, blacksmith shop, and necessary mining tools. Power for milling is furnished by a 4-cylinder Busch-Sulzer Diesel engine and a 125-horsepower caterpillar Diesel engine both connected to alternating-current generators. The company also owns other mining equipment, a partly equipped machine shop near the mill, and an office building at Austin.

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The principal rock in the most productive portion of the district is quartz monzonite, which is cut by a series of basic dikes. The ore is in shoots in a number of quartz fissure veins frequently displaced by faults. While there are a number of other small veins in the district, the principal production has been derived from a series of parallel veins having a northwest-southeast strike and a dip to the northeast. The veins are narrow, ranging in width from a few inches to 3 feet. The average width mined in former years was probably about 15 inches. The ores, however, were unusually rich, which in a great measure compensated for the narrowness of the veins. From the old records the grade of the ore mined in the early days apparently ranged from $100 to as high as $400 per ton and averaged about $175 per ton. Silver chloride was the principal economic mineral in ores from the surface to a depth of about 75 feet. At that depth water was present, and the mineralization changed. Below water level the ore minerals are ruby silver (both light and dark), polybasite, enargite, stephanite, ibnite, silver glance (?), galena, sphalerite, copper glance, pyrite and marcasite, arsenopyrite (pyragyrite and proustite), tetrahedrite, and chalcocite.

Barite deposit

Barite occurs in the Reese River district 9-1/2 miles southeast of Austin and 1 mile north of the Lincoln Highway. A group of three unpatented claims owned by Gus Laurent of Austin covers the principal veins. Although the deposits have been known for a number of years, their exploitation is handicapped by their distance from consuming centers; Battle Mountain, the nearest rail shipping point, is 100 miles northward.

The barite occurs in a series of veins, variable in strike, with a general flat dip averaging about 20° and ranging from 1 foot to 5 feet in width, averaging about 4 feet. The country rock is a decomposed monzonite. Deposits have been opened by a number of surface cuts and short adits totaling not more than 100 feet in length. The barite is of good quality, crystalline in character, easily crushed, and virtually free of any impurities except a small amount of oxide. Judging from the wide distribution of barite float found in the locality, a number of other veins probably are present, in addition to those already found. The veins are covered with a mantle of sandy detritus to a depth of 1 to 6 feet, and prospecting could be done easily by trenching with tractor and scraper, if such work were warranted.

SKOOKUM DISTRICT

The Skookum district is in the south end of a group of hills on the west side of Reese River Valley 9 miles west of Austin. Silver-gold float was discovered in this area in 1907 by an Indian who noticed fragments of mineralized quartz that had been dug out by a badger. The Indian sold his discovery to the Lemaire brothers, of Austin, who began development work in 1908. In the same year rich ore was discovered by James Watt; when the discoveries became known a large number of locations were made and a short-lived boom ensued. In the summer of 1908 two tent towns, known as Gweenah and Skookum, sprang up and attained a combined population of 200, but the following

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year the camps were virtually abandoned. The Gweenah mine has been the principal producer; and, according to Rene Lemaire, the production of the district has been about $100,000, all of which was shipping ore. In recent years there has been little activity.

Gweenah Mine

The Gweenah mine comprises a group of seven unpatented claims owned by Rene and Louis Lemaire of Battle Mountain. The property has been inactive since 1935.

Development includes several shafts sunk by lessees in the early days, the deepest being 125 feet, and other workings totaling approximately 1,200 feet. There is little mining equipment on the property.

The principal vein strikes N. 30° W, with a dip ranging from nearly vertical to 60° northeasterly; it ranges from a few inches to 4 feet in width and in places splits into several branches. The country rock is quartzite. Ore minerals are argentiferous tetrahedrite, pyrite, chrysocolla, with a little lead, in a gangue composed chiefly of brecciated quartz stained with iron oxide.

The smelter returns on the last carload of ore shipped from the property on September 20, 1935, to the International Smelting & Refining Co. by R. W. Lemaire furnished the following data:

Metal quotations:	Gold	$35.00 per ounce
	Silver	.77 per ounce
		Ounces
Settlement assay:	Silver	155.35
	Gold	.1425
		Percent
	Copper	0.26
	Lead	.55
	Zinc	Nil
	Insoluble	93.05
	Iron	2.35
	Sulphur	.15
	Lime	.9
		Pounds
Wet weight		70,460
Moisture, 1 percent		704
Dry weight		69,756 or 34.878 tons

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Metal payment:	Silver, 95 percent at $0.77 per ounce		$113.639
	Gold, 91 percent at $35 per ounce		4.539
	Gross value per ton		118.178
Treatment charge:			5.50
	Net value per ton		112.678
	34.878 tons at $112.678		3,929.98
Deductions:	Sampling	$21.14	
	Assaying	8.00	
	Hauling (sampler to smelter)	35.00	64.14
	Net proceeds		3,865.84

This shipment was hauled by truck from the mine to the Utah Ore Sampling Co. plant at Murray, Utah.

WASHINGTON DISTRICT

The Washington district lies on the west slope of the Toiyabe Range near the boundary between Lander and Nye Counties, 35 miles south-southwest of Austin. It was organized in 1863, and for several years thereafter a number of mines and prospects were located and actively worked in San Pedro, Cottonwood, and San Juan Canyons; but with the decline of silver mining in the Toiyabe Range, the district became inactive and remained almost forgotten for many years. The amount of silver mined from this area in the early days is unknown, but in all probability was small. In recent years the only production has been several shipments of ore made by lessees from the Camp Bird group of claims.

Camp Bird Group

Camp Bird group, owned by Mrs. Rose Warner of Austin, Nev., comprises 16 unpatented claims between Washington and Cottonwood Canyons about 1 mile southeast of the old camp of Washington. The property was first worked in the late sixties, when considerable development work was done and some production was obtained. In 1923 the property was acquired by New York interests that installed a tramway and erected a 50-ton cyanide plant; after a short time the company ran into financial difficulties and stopped work. In recent years a small amount of shipping ore has been mined by lessees.

Development comprises an adit 900 feet long and other workings totaling several thousand feet. In 1938 the road to the property was washed out by cloudbursts, so that it was inaccessible by automobile.

The prevailing formation in the vicinity is lime shale and quartzite. The principal vein, known as the New Hope, consists of quartzite breccia recemented by quartz. It has a north and south strike and a flat dip eastward. The ore minerals are argentite, galena, tetrahedrite and their alteration products. A small lot of ore shipped to the McGill smelter of the Nevada

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Consolidated Copper Co. by George L. Brandt and Peter Dory in June 1937 furnished the following data:

Metal quotation:	Silver	$0.766 per ounce	
		Ounces	
Settlement assay:	Silver	49.69	
		Percent	
	Silica	90.6	
	Alumina	4.8	
	Iron	1.1	
	Lime	.1	
		Pounds	
Net weight:		14,320	
Moisture, 1.07 percent		153	
Dry weight		14,167 or 7.083 tons	
Metal payment:	Silver, 90 percent at $0.766 per ounce		$34.26
Treatment charge:	Base charge	$6.00	
	Credit (silica)	.765	
	Net treatment charge.....	5.235	5.235
	Value per ton		29.025
	7.083 tons at $29.025		205.58
Deductions:	Hauling 7.16 tons at $8	$57.28	
	Sampling	5.00	62.28
	Net proceeds		143.30

FUTURE OF MINING IN LANDER COUNTY

From the viewpoint of past production, silver has been the most important metal mined in Lander County, the principal period of production having been between 1862 and 1880. With the exhaustion of the richer ore bodies, silver mining declined and the mining of gold and copper ores became increasingly important. At present, mining activity is confined largely to leasing operations, chiefly in the districts tributary to Battle Mountain. For many years Battle Mountain has been one of the prominent leasing areas in the State, and during the past 4 years the production of shipping ores, mainly gold with some copper, has averaged between 700 and 800 tons per month. The production of copper ores is dependent on market conditions; with a better price for copper, an appreciable increase in the production of such ores can be expected. In general, the gold ores of the Battle Mountain region vary considerably in character, and it is because of the metallurgical difficulties involved that they are not treated in a local custom mill.

Future production of metals in Lander County appears to depend largely upon the rehabilitation of old mines and additional prospecting in the known mineralized areas. In regard to further prospecting, a recent development in mining in the northern part of the State has been the discovery and exploitation of a number of gold deposits in sedimentary rocks. Among such discoveries

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may be mentioned the Getchell mine in Humboldt County, the Standard mine in Pershing County, and the Goldacres mine, Buffalo Valley Mines Co., Copper Canyon mine, and Johnson-Dolezal lease in Lander County. It is often stated that Nevada has been thoroughly prospected, and while it is true that most of the mineral deposits with prominent surface features have been found, other deposits, such as the sedimentary gold deposits, which are not so conspicuous, have been overlooked. In general, the sedimentary gold deposits do not possess easily recognizable surface indications, and consequently they were passed over in former years. Moreover, the gold in such deposits usually cannot be detected by panning, so that the early prospectors, who depended largely on panning, were misled. No doubt, deposits similar in character to those already found remain to be discovered in Lander County and other areas in the State, where sedimentary formations, like shale and limestone lying in proximity to acidic intrusives, are common.

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